ENGLISH SPECIFICATIONS.

Worthing Local Board.—Sea Water Supply.—General Conditions.

1. *Intepretation Clause.*—In this specification the following words shall be considered to have the meaning hereby ascribed to them:—"Local Board," the Local Board for the district of Worthing, acting under the Local Government Act of 1875. "Engineers," Isaac Shone and Edwin Ault, of Wrexham, the persons duly authorized by the local board to act as engineers in the construction of the intended works, or the authorized representative duly appointed by the engineers. "Town Surveyor," Walter Horne, or the surveyor for the time being employed by the local board. "Contractor," any person or firm contracting for the works herein specified. "The Works," any works shown or implied on the plans, sections, or drawings furnished with the specification, or during progress of works, or in this specification, together with any extra work which may be found necessary.

2. *Data of Contract.*—This specification and the drawings Nos. 1 to 6 herein referred to shall be the ground or data upon which the contract is based.

3. *Tools.*—The contractor shall provide at his own expense all tools, pumps, tackle, implements, and all timber for shoring, strutting, poling, and every other appliance necessary for successfully executing the entire works.

4. *Dimensions.*—All dimensions figured on the drawings, or stated in this specification, shall in every case refer to the works when executed.

5. *Power to vary Works.*—The engineers shall have full power to vary, extend, or diminish the quantity of work specified and shown in the drawings, and also any alterations in the quality or character of the works, without vitiating the contract, but all such additions or deductions shall be added to or deducted from the amount of contract, as the case may be, at the rates specified in the schedule of prices delivered with the contractor's tender.

6. *Quality of Materials and Workmanship.*—The contractor shall execute with the best materials and workmanship of their respective kinds the whole of the works comprised in the drawings and this specification.

7. *Rejection of Materials.*—All materials which are, in the opinion of the engineers, of inferior quality, or in any way defective shall be removed from the works immediately upon the contractor receiving notice thereof, and he must provide others of approved quality in lieu of same. Any works which may be discovered as having been built of defective materials shall be taken up, removed, and reconstructed upon demand of the engineers. In case of non-compliance with the requisitions of the engineers in this respect, they shall have full power to remove such materials and works, substitute others in their place, and charge the expense of both the removal and substitution to the contractor.

8. *Power to proceed with the Works.*—If, at any time it shall appear to the engineers that the works, or any portion thereof, are not being executed in a sound and workmanlike manner, or if the contractor refuses or neglects to comply with the order of the engineers, or if the contractor shall become bankrupt, file a petition for liquidation, or composition with, or make an assignment for the benefit of his creditors, or suspend or delay the works, except on account of the weather, or should the contractor not proceed with due diligence with his contract, then the Local Board shall have full power, after the lapse of seven days' notice given to the contractor, or left at his reputed residence, to suspend further execution of the works by the contractor, and take the whole, or any part of the contract out of the contractor's hands, or employ another contractor or workmen to perform the whole or any part of the contract. The cost of such works and materials shall be deducted from any money that may be or become due to the contractor, or shall be recoverable from the contractor.

9. *Carriage of Materials.*—The contract shall provide for the carriage and cartage of all materials, as well as any horse or team work found necessary during the execution of the works.

10. *Materials to be the Property of the Local Board.*—All materials, plant, machinery, implements, tackle, timber for shoring, poling, strutting, etc., brought by the contractor upon the works shall be the absolute property of the Local Board for the time being, and shall not be removed during the progress of the works without the written order of the engineers, and in case of suspension of the work by the engineers, for any act or default of the contractor, or of the work being taken out of his hands, the same shall be subject to be used as ordered by the engineers in or about the completion of the said works.

11. *Traffic.*—To prevent accidents and inconvenience to the public during the progress of the works, the contractor shall, at his own cost, provide safe cross passages of planks over the trenches and excavations for the use of foot passengers and occupiers of adjoining properties, and he shall also provide for the through traffic of roads or streets by the erection, if necessary, of bridgeways or temporary roads, which shall be constructed by the contractor at his own expense.

12. *Watching and Lighting.*—The contractor shall provide at his own cost a sufficient number of watchmen, and shall during the night keep fires or lamps of a sufficient size, in the opinion of the engineers, burning at such places as may be necessary during the construction of the works.

13. *Shoring and Strutting.*—The contractor shall at his own cost properly shore, strut, and protect any buildings, houses, walls, fences and other properties adjacent to the works where found necessary; and shall make good, restore, and repair houses, buildings, walls, fences, or other properties that are disturbed, destroyed, or in any way injured during the construction and maintenance of the works.

14. *Damage to Works.*—In case any damage or injury happens to any part of the works or materials on the ground, by the workmen employed, malicious and wilful destruction, theft, inclemency of the weather, or by any accident whatever, the contractor shall repair, reconstruct, or replace the same at his own cost, so that at the termination of the contract of the works may be perfect and complete in every respect.

15. *Gas and Water Mains.*—Wherever excavations or cuttings are made under any gas or water mains, or other property of like nature, they shall be supported by means of timber props from the bottom of the trench, which shall be left in the works at the discretion of the engineers. But should any of such property be fractured, or in any way damaged by reason of the works, or during the term of maintenance, the contractor shall relay the pipes and make good all damage, at his own cost, and to the entire satisfaction of the parties in whom the properties are vested.

16. *Restoring Drains.*—The contractor shall, ot his own cost, provide for the flow of water, and make good any sewer, drain, or watercourse interfered with by the construction of the works.

17. *Allowance of Time for Suspension of Works.*—Should it be found necessary, on account of the inclemency of the weather, or anv other cause, to suspend the execution of the works, or any part of them, at any period, the engineers shall have full power to do so, without any extra payment being demanded by the contractor, but the period during which the works may be so suspended, shall be allowed to the contractor in computing the time of completion of his contract; but, in case the contract, or any part thereof is not resumed, the engineers shall value the amount of work executed, or materials provided, and any damage the contractor may sustain from the stoppage of the works, and the award of the engineers shall be final and binding upon all parties concerned in the contract.

18. *Sub-letting.*—The contractor shall not sublet any part of the works to any other contractor or workmen, without first obtaining the consent of the engineers in writing.

19. *Works to be carried out under the Control of the Engineers.*—The work herein specified, and shown on the drawings No. 1 to — inclusive, as also the mode in which they shall be executed, shall be under the absolute control of the engineers, or any other person authorized by them to give instructions.

20. *Dismissal of Incompetent Fore- and Workmen.*—The engineers shall have full power to dismiss from the works any of the contractor's foremen and workmen, who, in their opinion, are incompetent, or have misconducted themselves.

21. *Examination of Works.*—If the engineers have any doubt as to the quality of materials or workmanship of any part or parts of the works executed, openings or excavations shall be made down to such part or parts, to allow of a full examination, and if the workmanship or materials shall be found in any way defective, the cost of making such examination and making good the work shall be borne by the contractor, but if found to be perfect such cost shall be allowed.

22. *Discrepancies.* — The specification and drawings are intended to be explanatory of each other, but should any discrepancies appear or any misunderstanding arise as to the import of anything contained in either the specification or drawings, the decision of the engineers shall be final and binding on the contractor.

Quantities.—The quantities in schedule annexed have been taken out carefully, but the engineers will not be responsible for their accuracy. They are merely intended as a basis on which the contractor shall form his tender.

Schedule of Prices.—The contractor will be paid only on the actual quantity of work completed, which will be ascertained at the final measurement of works, and at their rates set forth in the schedule of prices.

23. *Omissions.*—Should there be anything omitted from this specification or from the drawings referred to therein, or from the schedule of quantities which is usually considered necessary for the execution and completion of works of this class and description, the engineers shall order, and the contractors shall execute, whatever may be wanting in respect thereof, and the contractor shall not obtain any advantage from such omissions, nor be paid any extra payment on account thereof, except in accordance with the schedule of quantities.

24. *Extra Works.*—Should the contractor be required to execute and perform extra work in addition to his contract, the contractor shall execute it, at the prices set forth in the schedule, but in case the class of work to be done is not comprised in the said schedule, then, and in such case a price shall be agreed upon in writing before commencing the work.

25. *Commencement of Works.*—The contractor shall commence the works immediately or within one week after notice in writing from the engineers to that effect.

27. *Maintenance.*—The contractor shall maintain the whole of the works in a state of perfect repair, order, and condition, for a period of three calendar months, dating from the engineers' certificate that the works have been completed to their entire satisfaction.

28. *Payments.*—The contractor shall receive payment of his contract by monthly instalments on the certificate of the engineers, at 80 per cent. upon the value of the work executed and

materials brought on the ground each month. The balance, 20 per cent., shall be paid to the contractor at the expiration of three calendar months, dating from the engineers' certificate of completion of any separate part, or the whole of the works, and providing that such separate part or the whole of the works are in a perfect state and good condition.

29. *Sureties and Contract.*—The contractor shall enter into a contract under seal for the perfect completion of the whole of the works herein specified and shown by the drawings, and he shall provide two responsible sureties who shall severally be bound with him in a bond of———for the due performance of the said contract and for the payment of any penalties to which the contractor may become liable under his contract.

30.—*Disputes.*—Should there be any dispute or difference of opinion with regard to the quality of materials, workmanship, measurements, or in respect of anything affecting the carrying out of the works, such dispute shall be settled by the engineers, whose decision on all points shall be final and conclusive.

Measurements.—The measurement for pipe laying shall be the lineal measurement of such when laid and jointed in the work.

All measurement relating to the excavation of earth, shall be taken from the actual size of the excavations.

32. *Measurement of Work Monthly.*—The work as it proceeds shall be measured up monthly by the engineers; the contractor will be at liberty to accompany them in order that they may agree on the measurements. Should the contractor or his representative neglect to do so, the engineers' measurements shall be taken as final and conclusive.

33. *Contractor to Set out Works.*—The contractor shall set out the works, and keep them correct in every particular, according to the plans and sections, or directions he may receive from time to time, and he shall also furnish, provide, and maintain sight rods, pegs and all labor required.

34. *Contractor to Verify Levels.*—The plans and sections are believed to be accurate, but the contractor will be held responsible for any error, and it will be for him to verify the sections and figures given.—*Contract Journal, London.*

OTHER CANTILEVER BRIDGES.

The principle of the cantilever bridge must have been known centuries ago, as there are many old bridges in Switzerland built in accordance with it. The new Niagara River bridge, however, is the first bridge of any magnitude actually built upon this system, The first one in Europe will be the great bridge across the Firth of Forth, Scotland, now building, The engineers in charge of the latter work are B. Baker, Civil Engineer, and John Fowler. Mr. Baker is considered the foremost bridge engineer, probably, in the world, and his publications in 1867 in London, entitled "Long Span Railway Bridges," contains what is regarded as the standard treatise on the cantilever principle. The Forth bridge was originally designed to be built after plans furnished by Mr. Gouch, the engineer of the ill-fated Tay bridge, which was blown down in a gale in 1880. Mr. Gouch's plans contemplated a stiffened suspension bridge at a cost of about $10,000,000. The disaster on the Tay raised a question as to the engineer's abilities, and Messrs. Baker and Fowler were engaged to investigate his plans and to provide others, if necessary. Mr. Gouch's plans were condemned and it was decided to build the bridge on the cantilever principle. Work was begun in 1881, and it is expected that the structure will be finished within two years, at a cost of £1,365,000. It is to be a double-track railway bridge, having two clear spans each 1,700 feet long, and two shore spans each 600 feet long the total length being 4,940 feet.

While the Central Bridge Compfany of Buffalo, have the honor of raising the first cantilever in America, the first design for a large span ever accepted was made by Charles Macdonald, President of the Delaware Bridge Company, of New York, for the New York and Long Island Bridge Company. This company was organized in 1875 to construct a bridge over the east and west channels of the East River at Blackwell's Island. The bridge was required to be of sufficient strength and rigidity to support the traffic of a double line of railway, two wagon-ways and two sidewalks. The two spans were to be respectively 734 and 618 feet, and present a clear height of 135 feet above mean high tide. Moreover, it was stipulated that in building the bridge no false works that would obstruct navigation were to be used. A series of prizes were offered by the bridge company, and a commission consisting of O. Chanute, C. E., Maj. Gen. J. G. Barnard, U. S. A., and Maj. Gen. Q. A. Gillmore, U. S. A., awarded the first premium in May, 1876, to the design for a cantilever bridge submitted by Mr. Macdonald. The cost of the bridge was to be $3,000,000, including the approaches. For various reasons, not affecting the design, the bridge has not yet been constructed. The Delaware Bridge Company is now engaged in constructing a bridge across the Ohio River, connecting the cities of Louisville and New Albany, to be half a mile long and have two cantilever spans of 490 feet each. The bridge will cost about $1,300,000, and will be finished next year.

A New Method of Sinking Shafts in Watery Ground.

A new method as invented by Herr Poetsch is described by Bergassessor G. Kohler, in the *Berg und Huttenmannische Zeitung*, No. 38, xlii., *Jahrganng*. September 21. 1883. It consists in freezing the water contained in that portion of the running ground which occupies the position of the intended shaft into a solid mass of ice, and then sinking through it by hand without having to pump any water. To this end a preliminary shaft of larger dimensions than the intended shaft is sunk down to the natural level of the water. A number of vertical bore-holes about one metre apart are then put down round about its sides at the bottom, so that they pass through the ground just outside the lining of the intended shaft. Others are put down within the area of the intended shaft, and one is put down in its centre. All of these bores are continued down to the bottom of the running ground. They are made by means of the sand pump, and are lined with sheet-iron tubes in the usual way. A circular distributing pipe with small copper tubes branching from it is placed at the bottom of the preliminary shaft. One copper tube extends to the bottom of each bore-hole, and each tube is provided with a stopcock. At the surface are several ice-making machines of the Carre type. The liquid intended to circulate through the bore-holes and effect the operation of freezing consists of a solution of the chlorides of magnesium and calcium, whose freezing point lies between — 35° C. and — 40° C. By means of a small force-pump it is made to circulate at such a rate that it leaves the cooling-trough with a temperature of about — 25° C. It descends into the distributing pipe, passes through the copper tubes to the bottom of the bore-holes, ascends outside the copper tubes to the bottom of the bore-holes, finds its way into a collecting-tube, reascends to the surface, passes through the cooling-trough, and then commences the downward journey again. Herr Poetsch estimates that, under ordinary conditions—that is, when the outer ring of bore-holes can be made in the ground outside the lining of the intended shaft—the freezing process will occupy from ten to fourteen days. When it has been ascertained by means of bore-holes that the wall of ice round about the intended shaft is thick enough, the operation of sinking is commenced. The ice is cut out by hand, and a descending cylinder of masonry or iron is carried down at the same time. The lining prevents the surrounding ice-wall from breaking inwards, and the bottom cannot burst upwards. Herr Kohler made a personal inspection of this process at the shaft Archibald now being sunk to the lignite beds at Schneidlingen, in Germany. The shaft passes through a bed of running sand four metres thick. Twenty-three bore-holes were employed in two rows near its sides. The freezing process was completed on August 10, last, when the running sand had become a compact mass of such great hardness that no impression could be made on it by the finger nail, and it was with considerable difficulty that a flake 15mm. thick could be broken from it. Sufficient data do not yet exist for estimating the cost of this process as compared with those already known, but it would appear that if the operation of freezing can be effected in two or three weeks, or even months, it will compare favorably with them in this respect under almost any circumstances. It may also be capable of application under a variety of circumstances not mentioned in Herr Kohler's article, such as damming back an excessive flow of water in solid ground, driving horizontal drifts or tunnels through mud and sand, and so on.

DECAY OF BUILDING STONES.*

BY W. WALLACE.

The author confines his attention to sandstones. Among the most important ingredients, beyond the silica, are calcium and magnesium carbonates, which, filling up the interstices between the particles of sand, form a firm mass; they amount to 0.52 to 12.58 per cent. of the whole. Alumina varies from 0.32 to 1.77 per cent., and is either a component of admired minerals or else of clay, which is injurious to the durability of the stone. Iron oxides are contained in all sandstones, in white stones apparently as silicates, and in red stones partially, at least, as free ferric oxide or hydrate. The color of the stone affords no indication of the amount of iron contained; thus a white stone from Kenmure contained 2.62 per cent. ferric oxide, another from Ravenscrag, 0.14 per cent., and a red-brown stone from Bothwell Park only 0.98 per cent. Some stones become disfigured with patches of ferric oxide; this arises from the oxidation of pyrites and the action of calcium carbonate and the air on the sulphate produced. Calcium sulphate and phosphate exist in small quantities, viz., about 0.1 per cent. The sp. gr. of the air-dried stone varies from 2.048—2.318, and the amount of water capable of being absorbed varies from 3.4 to 7.2 per cent. It may fairly be taken that the durability of a stone depends on its impermeability to water, its density and the amount of binding material contained. It is noticeable that building stones begin first to decay immediately below any flat projecting surfaces which allow the rain to collect and then percolate *through* them, and thus dissolve or alter the binding materials. All such horizontal ledges and protections should therefore not be made flat, but have a steep slope given to them. In order to render the stone impervious it may be painted or treated with silicate of soda or a preparation called "Alexinoton" but the stone must first be allowed to dry as completely as possible.

CAPT. ANTONIO PELLETIER of Prescott, Arizona, is the patentee of the Pelletier Pavement. The Capt. says he has a large contract to pave the City of Mexico. He was the plaintiff in a suit brought last week in a Chicago court on account of an alleged black mailing attempt on him.

*Abstract of article in *Chemical News*, published in *Journal of the Chemical Society* for November.

Railroad Building in Turkey.

Verily, "the world moves." If any fresh evidence of the fact were needed, it would be found in the fact that his bastinadoing highness, the Sultan, has indicated his willingness to accept Yankee aid—even aid from the hated Giaour Yankee—in developing the railroad system of his dominions. In order to instruct the Giaours aforesaid as to his lofty good intentions toward them in this regard, he has transmitted through his consular representative in Philadelphia a pamphlet addressed chiefly to capitalists and contractors, in which is succinctly set forth the steps necessary to be taken to secure a "concession" for building a railroad in Turkey. According to this document the Sultan is pretty well posted as to what constitutes a good railroad, and does not propose that outside barbarians shall "put it on his eye" to any appreciable extent. The contractor who receives a concession is required to deposit with the Minister of Public Works within a specified time complete plans of the road; which are to be subject to approval or modification by the Government, within three months of their presentation to the Minister. Within a further specified time agreed upon the contractor must bind himself to begin the construction of the work, and to complete it before the expiration of a fixed time, allowance being made for causes of delay beyond his control. The work of construction is to be under the supervision of at least one Government commissioner, who will draw upon the contractor for his salary. Land for the line will be taken under the appropriation laws of the empire, thus doing away with the great bother in the enlightened United States of securing the right-of-way. Only one track will be laid, but land will be taken to accommodate two. When the receipts of the road amount to $3,725 per English mile a second track must be put down by the contractor at his private expense. All necessary supplies are admitted free of custom duties, and the lands, funds and earnings of the line are to be exempt from taxation of all kinds. Such timber as is needed may be cut from the State forests without charge.

As security for the satisfactory fulfillment of the contract, a sum to be agreed upon will be deposited in the Ottoman Bank by the contractor, which is not to be returned until the final acceptance of the work. When completed, the road will be examined primarily, and a year later a second and more critical examination will be made by technical experts. Then, if it conforms to the requirements of the Government and is in every way up to the specifications of the contract, it will be definitely accepted. Meantime all the works and the rolling stock are to be kept in perfect order and repair by the contractor. After thirty years the Government will have the right to purchase the road by paying annually, until the end of the contract, 50 per cent. of the net receipts for the preceding five years. The contractor will be permitted to erect a telegraph line for railroad business solely, but will not be allowed to transmit over it private or general messages. He will also be allowed to work all mines that may be discovered along the line of the road. Soldiers, sailors, convicts and their keepers are to be carried at half fare. Should the contractor from any cause default in beginning or completing his work, the security will be forfeited to the Government, and the incomplete works to be sold at auction, for whose benefit the representative of the Sultan does not state.

The specifications provide for thorough construction and equipment, no public highway being permitted to cross it at grade. For first-class passengers the rate of fare is fixed at about 5½ cents per mile; second class, 4½ cents, and third class, 2½ cents; with a provision for an increase of 30 per cent. on express trains carrying only the first and second class. Here is a chance for some of our unemployed railroad builders.—*Railway Reporter.*

PATENT LICENSES.

A novel and important point with regard to licenses, where a patentee has patents for the same invention in various countries, was decided by the Court of Appeal on Saturday last, in the case of the Societe Anonyme des Manufactures de Glaces, &c., *v.* Tilghman's Patent Sand Blast Company, Limited. Mr. Tilghman, the inventor of the sand blast process, patented his invention in various countries, among them being England and Belgium. He assigned his English patent to the defendants, an English company, in which he was largely interested, and he also gave the company a power of attorney by which they were enabled to deal in any manner with the Belgian patent, of which they became practically the owners. The company granted a license under the Belgian patent to the Belgian Societe (the plaintiffs), to use the invention in Belgium. Under this license the Societe contended that they were entitled to import their goods, made according to the invention, into England, but this right was disputed by the company, who issued circulars warning the public against dealing with such importations. The Societe thereupon brought the present action against the Company to restrain the issue of these circulars. The question at issue was argued before Mr. Justice Pearson, upon a motion for an interlocutory injunction, and from his decision against the Societe they appealed, the result being a confirmation of the decision. The case was heard before Lord Justices Cotton and Lindley, counsel for the Societe being Messrs. Cookson, Q. C., and Farwell, and for the Company Messrs. Aston, Q. C., and W. R. Bousfield. Their lordships held that, even where a person who is the absolute owner of both an English and a foreign patent for the same invention, grants a license to work the invention under the foreign patent in the foreign country, the license gives no right to import the goods into England, unless express words are inserted, which would amount to a license under the English patent also.

The Adoption of a Standard Brick in Switzerland.*

BY F. FAYOD.

The best method of developing the art of building in brick has occupied the attention of architects and engineers in Switzerland for some years, and with this view it has been determined to attempt to fix a certain standard size of brick, and a report was presented to the Swiss Society of Architects and Engineers, in which the dimensions recommended were 9·84 in. by 4.72 in. by 2.36 in. As, however, these dimensions were not agreed to by all sections of the society, a special federal comission was appointed in December, 1882, to inquire into the subject.

The author first of all gives a brief account of the bricks that were used by the Assyrians, Egyptians, and other ancient peoples. He then gives tables of the dimensions of the bricks that were used from remote periods up to the 17th century, and of those in use at the present day in Italy, France, England, Belgium, Austria, Germany and Switzerland. From these tables he shows that the standard size should be between the limits of of 9.45 in. long, 4.33 in. broad, and 1.97 or 2.56 or 2.76 in. thick, and 11.63 in. long, 5.12 in. wide, and 1.97 or 2.56 or 2.76 in. thick, or, taking a mean, the size should be 9.84 in. by 4.72 in. by 2.36 in. This size is made at the present time, as is also that of 9.84 in. by 4.72 in. by 2.76 in. The author is greatly in favor of the thicker brick, and a great deal of the paper is taken up with a discussion of the possibility of properly burning it, many of the Swiss brick-burners having stated that they cannot burn bricks having a greater thickness than 2.36 in. In reference to the thicker bricks he remarks: 1st, that the other dimensions remaining the same, the resistance increases with the thickness. 2nd. There is, perhaps, rather more difficulty in drying a thick brick, but care in mixing the beds of clay, the addition of sand, gradual drying, etc., will readily get over it. 3rd. In burning, the bricks must be carefully placed in the kilns, as the gas will follow the shortest route to the outlet; the bricks must be arranged so as to oppose obstacles to its escape in this direction, while facilitating its passage by the longer route. The bricks after being dried in the sheds, should be further dried by hot air from the kilns before being burnt. All apertures by which the air could pass into the kilns must be carefully closed, and the cooling of the bricks must be gradual. 4th. When color is of importance, attention must be paid to the fuel. Coals of inferior quality frequently contain extraneous matter which is deleterious to good color, and also to the weathering qualities of the bricks, and is sometimes the cause of efflorescence. 5th. With the same materials there will be a better output of first-class bricks with a 2.76 in. than a 2.36 in. thickness, because vitrification does not begin so soon. Of course, the best quality cannot be obtained from clays which are very chalky, earthy, or sandy, but with careful manipulation very fair bricks may be made from very moderately good earth.

The author conducted some experiments at the Horn brickfields of Mr. Bourry, where the bricks are made by machinery and burnt in Hoffman kilns. These experiments were performed with eight varieties of earth, three blue, three yellow, one sandy, and one earthy. Bricks were made from each variety separately, and also from mixtures of different kinds; their dimensions were 9.45 in. by 4.53 in. by 2.76 in. They were dried under different conditions, according to their kind, and burnt carefully in kilns with other bricks. The result was that each different clay and each mixture produced bricks of different colors, but all well-burnt and sound.

With regard to the question of price, of course if the manufacturer sells his bricks by the thousand, without reference to size, the smaller they are the better for him. The contractor, too, is apt to prefer small bricks, because with them he uses more mortar, which costs him less; but, on the other hand, he requires more bricks per cubic yard (the number of bricks of different sizes in a cube metre of work are given), and there is more labor in setting them, so that what he gains in one way he loses in another.

In regard to the quantity of mortar, Dr. Boehme's experiments at Berlin, in 1875, proved that no more mortar than was actually necessary to keep the course horizontal and effect the cohesion of the bricks (for which purpose joints of 0.4 in. thick are ample) should be used, as, whether the mortar becomes more or less hard than the bricks, the result is in either case to reduce the strength of the work. Experiments made with blocks of twenty sound bricks, one set of blocks cemented with various kinds of mortar and cement (the joints 0.4 in. thick), another set consisting of bricks laid dry, and surrounded with cement simply to keep them together, gave, as mean resistences to compression: For the first set, 1,618 lbs. per square inch to cause splitting, 1,934 lbs. for the destruction of the bricks; and for the second set 2,202 lbs. per square inch to cause splitting, and 2,291 lbs. per square inch for destruction, showing that the dry bricks gave a mean resistence of one-third more than those set with mortar before splitting, and one-fifth more before destruction. The author therefore concludes that to secure the greatest strength thick bricks with a minimum of mortar should be used.

The author suggests that the price of bricks per thousand should vary according to the number reguired per cubic metre of work, so that the manufacturer may be paid according to the size of the bricks. Finally, he recommends that the standard brick should have the dimensions 9.84 in. by 4.72 in. by 2.56 in.

* Abstract of Report presented to the General Assembly of Cantonal Delegates at Berne, published in the *Bulletin de Societe Vaudoise des Ingenieurs et des Architectes*. taken from Abstracts of Papers in Foreign Transactions, etc., published by the Institution of Civil Engineers.

Liability of Sleeping Car Companies for the Robbery of Passengers.

In the Supreme Court of Pennsylvania a decision was announced in Pittsburgh, on November 12th, in the case of the Pullman Palace Car Company against William Gardner, who on one occasion occupied a berth in one of the sleeping cars of the company between Pittsburgh and Harrisburg, when he was robbed of his watch and other valuables worth $350. He brought an action in debt agains the company and recovered the amount of his loss.

From this the palace-car company appealed, and the Supreme Court affirms the judgment of the lower court, and in an opinion says: "We have carefully examined the evidence and considered the assignments of error. Conceding that the company is not liable in this action as an innkeeper or common carrier, yet a reasonable and proper degree of care is imposed on the company. Whether it did exercise that degree of care under the circumstances was for the jury to decide. The main object in taking passage in such a car is to permit the passenger to sleep. While in that helpless condition a duty rests on the company to provide reasonable care and precaution against the valuables of a passenger from being stolen from his bed or from the clothes on his person. This is not the case of a robbery by force and violence, but by stealthy larceny. Unless a watchman be kept constantly in view of the center aisle of the car, larceny from a sleeping passenger may be committed without the thief being detected in the act. While the fact that another passenger in the same car was robbed the same night was not relevant to prove that the defendant in error was in fact robbed, yet it was admissible as bearing on the absence of proper care by the company. The case was submitted to the jury in an able and correct charge. We see no error of which the company can complain. Judgment affirmed."

The Tampa, Florida, *Tribune* learns that the Plant Investment Company has quite a large force of hands now at work on the South Florida Railroad, between Fort Cummings and Bartow. Several miles of way are now cleared, and the work of grading and track-laying will be pushed forward so as to complete the branch as soon as the main line is ready for business.

BOSTON WATER METERS ONCE MORE.

The report of the Water Board calls for an appropriation of $150,000 "to put recording meters on all manufactories, breweries, stores, business establishments, hotels, tenement houses, and all other places where a large quantity of water is used, or where waste prevails." The Water Board does not name the Tremont meter which it proposes to use for this purpose, but as it had previously adopted that meter after a curiously brief and inadequate test, it is to be inferred that the proposition of the Board means that the city shall invest $150,000 more in the meter, with whose curious and interesting history we have acquainted our readers.

Before any such appropriation of the city's funds is made, there are a few questions which should be answered.

First of all, what has become of the large appropriation already made for this purpose?

If it is claimed that it has been expended in contracts for Tremont meters, how many of these meters have actually been manufactured up to date?

How many Tremont meters have been put in use in Boston?

Will the Water Board inform us where we can see these Tremont meters in successful operation?

Before the city goes farther in expenditures in this direction, is there any honest objection—we take the liberty of emphasizing the word honest—to having a public, impartial and adequate test of the various meters in the market, in order that the question of superiority may be satisfactorily settled?

We are not arguing against the meter system, but against covert and underhanded methods in its introduction. We are not even alleging that the Tremont meter is not the best in the market, but we insist that the fact ought to be clearly established before the city is committed to heavy expenditures for the purchase of them. A lot of water meters was among the useless lumber which the Tweed ring left to New York. They are now valuable only for old junk. If we are to have $150,000 or $200,000 in water meters, let us make sure that the city is getting its money's worth.—*Boston Journal*, Dec. 11th.

TRADE PUBLICATIONS.

We have received from George W. Parsons, Supt. of the department in question, a copy of the Pennsylvania Steel Company's "Descriptive Catalogue of Railroad Switches and Frogs, Switch-stands and Inter-locking Switch and Signal Apparatus."

The work commences with a history of the origin and growth of the Company, gives a statement of the annual out-put of steel ingots and rails, describes the process of manufacture of Bessemer steel rails, and presents in tabular form some useful information relating to the equipment of a railroad.

As suggested by the title, the greater part of the book is devoted to an illustrated description of frogs, switches and signal apparatus. This matter is important and interesting to every engineer and railroad man, as giving the latest and best practice, together with the plant as manufactured by one of the most favorably known companies in the country. The illustrations throughout are well executed, and, with the accompanying text, furnish a fund of information on these subjects never before gathered together within the covers of a single volume. The system of Inter-locking Switches and Signals is made especially clear, and for this if nothing more the author, Mr. Parsons, is deserving of the thanks of all railroad men.

Pound Manufacturing Co.

We are in receipt of an illustrated circular describing the system of Canal Excavation, introducing the different compact and effective machines made by this company, and successfully used on the Welland, Lachine and Cornwall Canals in Canada, and the Erie, Illinois and Michigan Canals in the United States.

The essential feature of this system is the working together of the Dredge and Derrick, the first excavating the material and depositing it in a box placed on the bank or on a scow, the second hoisting this load (7 or 8 tons) and swinging it to the place of deposit. The working rate of these machines is 60 revolutions per hour with Dredge digging in 30 feet of water, and the Derrick hoisting 50 feet and throwing material back 200 feet. A detailed description of these machines will be sent to parties desiring it by the Pound Co., Lockport, N. Y.

The Improved Steam Shovel (Otis patent) can be operated by three men, and in ordinary material will excavate and deposit on cars or in carts, from 1,000 to 2,000 cu. yds. per 10 hours and in doing this work will only consume 1,000 lbs. of good coal.

The Lockport Dredge is recommended for its simplicity, all the movements being made with one engine; all hard working parts are made of crucible cast steel; the shafts of hammered iron with extra long journals and gun metal boxes.

The Man for Engineers to Know.

Special to the *Globe-Democrat*.

WASHINGTON, D. C., Dec. 8.—Among the mysterious signatures upon the register at Willard's to-night, was that of ex-Senator H. A. W. Tabor, of Colorado.

"How about that new house you are going to build in Washington?" was asked by your correspondent.

"Well, I have not selected the site yet, but have determined to build here during the coming year. Yes, I shall build me a house here before long," said he.

"Where are you now from, Senator?" was asked.

"New York, and we are about to engage in a great venture. We are going to build a railroad from New York Bay to San Francisco. The capital will be foreign and amount to $153,000,000 full paid. Mr. Jewett, of New Jersey, myself and others are the projectors, and we are engaged in making up our directory. Mr. Jewett, will go West at once, stopping at Chicago and elsewhere. The road will strike the latter city, thence to Denver and through to California. We will surely begin its construction at an early day."

THE KANSAS CITY SEWER SYSTEM.

Mr. Octave Chanute Mem. A. Soc. C. E. formerly Chief Engineer of the Erie Railway read a paper at the meeting of the Kansas City Academy of Science on the 30 ult., on the sewerage system of Kansas City. Mr. Chanute dwelt upon the importance of adopting sewerage and spoke of the different systems. The combination as in vogue in Kansas City he regards an objectionable one. It was an expensive system and the sanitary results obtained from it were not satisfactory. In this system storm water drainage and the sewerage or waste drainage, were combined. A separate system was recommended by which the storm water should be carried away by surface drainage. This storm water could be conveyed away by surface drainage and could be utilized in washing the streets. Where the accumulation became objectionable, it could be transferred to a sewer, and thence to some ravine or passage way to the river. When surface water was thus carried away and not mixed with contaminating substances in a sewer, it could be exposed to the air while it was being carried away, and the whole atmosphere would not be tainted as in the case of exposing the matter in a combination sewer. Where the combination system was used, the matter had to be conveyed underground the entire distance desired, as exposure to the atmosphere could not take place unless the germs of zymotic disease were spread. The impression seemes to prevail in Kansas City that the city is not as healthy as it was in the early days of its history.

Mr. Chanute recommended the Waring system. It was invented (?) by Mr. George E. Waring, and was in use in Memphis, where it had proved a success. The sewer pipes were small as compared with the pipes of the combination system, being from 6 to 9 inches in diameter, and they were constructed of material that would not absorb sewer gas, and would not become affected by the action of substances passing through the pipes. No surface water was allowed to pass through these pipes, but they were flushed at such intervals as should be deemed proper, by automatic tanks. These tanks should be constructed partially underground and should hold from 100 to 150 gallons of water apiece. They are supplied by an arrangement that fills them slowly, and when the limit of their capacity is reached, the tanks discharge themselves, thus flushing the sewers. Kansas City was especially adapted to the introduction and use of the separate system.

According to the figures given in the report of the engineer of this city, the cost of the 307 acres sewered up to December 31st, 1882, was $314,814. The number of acres yet to be sewered was 2,600, and at a cost of $1,026 per acre, as indicated by the data given, the cost for this would be $2,667,200. This would make a total cost of 2,982,414 for the combination system. The cost of the introduction of the Waring system he estimated at much less. The number of acres sewered during the year of 1883 Mr. Chanute placed at 100, and the cost of this at $70,000. The cost of sewering 2,500 acres by the separate system, at $217.80 per acre, would be $544,500, and the storm water sewers to be built hereafter were placed at $150,000, making a total cost of $1,079,414.

Many questions concerning the utility of the system and its peculiarities were asked Mr. Chanute at the close of the reading of the paper, and the thanks of the academy were tendered to him.—*Kansas City Times*.

THE TOPOGRAPHER.

The topographer must be a man capable of correctly interpreting the face of nature, and for giving such intelligent graphical expression to his impressions, that a person unfamiliar with the ground may obtain, for all practical purposes, a sufficiently accurate knowledge of its features to enable him to decidethe questions at issue.

This involves a careful training of the eye and hand in the estimation of distances and angles, the exercise of judgment in laying out and prosecuting the work, a knowledge of the conventional methods of representing surface or underground features, physical alacrity and endurance in the collection of the data, courage in making a reconnaissance in an enemy's country, skill as a draughtsman in free-hand and mechanical drawing and in colors, and a good mathematical training, as a basis for the solution of the many interesting and novel problems continually arising in practice. In short, the requirements are such that only a person of good judgment, temperate habits, active temperament, and scholarly attainments, can hope to excel in this profession; and hence it is that the query it so often asked, "*Can you recommend a good topographer?*"—a question of great importance to the projectors of any work of magnitude, whether it be the establishment of a line of communication, the founding of a city, the supplying of a community with the necessaries of life, the removal of sewerage, the laying out of parks and grounds, the opening and working of mines, or the impounding of water for power or for irrigation.

From this general review of the field, it would appear that the qualifications of the topographer are of a high order, and of such a nature as to be acquired only by patient and persistent efforts in the direction of his goal.

It is not within the province of this work to treat of the accessories which are requisite to success—as mathematics, physical training, etc.—but to deal directly with the technicalities of the service, and the most direct methods of obtaining good results. With this end in view we will take up the subject in its natural order, and treat first of the methods of acquiring a correct impression of the surface to be represented—or more briefly, How to observe; second, the method of giving expression to the observations thus made by records and drawings, or graphical representation; third, the determination of results by analytical, graphical methods, or computations; and fourth, the applications, which may be made directly from the data thus furnished.—From advanced sheets of "The Topographer," by L. M. HAUPT.

The Admixture of Less Valuable Ingredients With Portland Cement.*

It had been already laid down as a proposition, at a previous meeting of the Association, that the sale of cement containing an admixture of foreign ingredients, added after the burning, was a fraud on the consumer, leaving out of the question how far the quality of the cement was impaired by such additions. A large number of makers had agreed to this decision (though others, secretly or openly, resisted it), and steps were taken to enforce its general acceptance throughout the trade. Apart from the moral considerations of fair dealing, the authorities of the association felt bound to investigate whether or not the addition of silicates, ground slag, and other materials, had an injurious effect on Portland cement, and they therefore caused inquiry to be made as follows:—(*a*) Concerning the influence on the quality of the cement of such additions made during or after the burning; and (*b*) The discovery of some simple tests to indicate with certainty the existence of impurities in the cement. Various members of the association conducted experiments bearing upon these points, and some of the results laid before the meeting were of much importance. Mr. Dyckerhoff undertook the following tests to prove the influence of various mixtures upon the quality of the cement:—(*a*) An examination of the strength of pure cement, and of cement mixed with powdered slag, limestone, lime and fine sand. (*b*) Of mixtures of slaked lime and sand, to which powdered slag, trass, and ultramarine were added. (*c*) Of mixture of cement and ultramarine. (*d*) Of cement lime-mortar, where the cement is pure or mixed with powdered slag. Tables are given of the breaking-weights of test-briquettes of samples of these different mixtures in various proportions; the tests were mainly made after twenty-eight days, but some samples were kept for half a year before being broken. The general results proved that, with the sole exception of ultramarine, all such additions to Portland cement impaired its strength.

Other investigations of a similar nature were undertaken by Drs. Herzog and Delbrueck, and Messrs. Bernoully and Heyn. Dr. Herzog made three series of experiments; the first intended to demonstrate the effect of various proportions of powdered slag, the second the influence of plaster of Paris upon mixtures of cement and ground slag, and the third the special relations which exist between the ground slag and the plaster. From the first series of experiments he arrived at similar conclusions to those of Dyckerhoff, namely, that all additions of ground slag are injurious to the strength of the cement, and that the reduction in strength is directly proportionate to the amount of slag employed. The result of the second series of tests proved that the addition of plaster of Paris improved the quality of the cement mixed with slag, but that the amount which could be so used with safety varied with each particular mixture, and that a maximum limit was soon reached. The third set of experiments indicated that in order to obtain the best results, the amount of plaster used must be proportionately increased in accordance with the quantity of ground slag employed.

The experiments undertaken by Dr. Delbrueck proved that the results of the admixture of foreign ingredients depended mainly on the fineness with which the cement was ground, or the extent to which the added material lent itself to improve the mere physical qualities of the mixture, in point of adhesion and cohesion. If to a cement, which is a mixture, in certain proportions of fine and coarse particles, a foreign material in a very fine state of sub-division is added, the result may be, owing to the more complete filling up of the interstices between the cement particles, that a denser, and therefore a stronger, mortar is formed. This points to the fact that normal sand, or one from which all the finer grains have been removed, is likely to give unreliable results when employed with adulterated cements. From a second set of tests Dr. Delbrueck proved that a mixture of finely-powdered slag had a corresponding effect on the cement mortar to that which would result from the addition to the mortar of an increased amount of sand; and the same held good with other materials used for degrading the cement. Mr. Bernoully arrived at identical conclusions from a set of independent tests, and he found also that plaster of Paris had a beneficial effect. He noticed that the cement to which ground slag had been added required more than the standard volume of ten per cent. of water on making from it the normal test-briquettes. Mr. Heyn's experiments were partly favorable, partly adverse to the addition of slag; they tended to prove that particular qualities of ground slag had, in some cases, a beneficial effect on certain kinds of cement. Mr. Blankenstein pointed out that mixtures of cement and powdered slag gave bad results when used for stucco. In addition to the facts adverse to adulteration, the instances in favor of this procedure are noticed. One firm have, they state, for years blended their cement with certain quantities of selected silicate of lime and other minerals, with the effect of considerably improving its strength.

With respect to the investigation of methods for detecting the use of adulterating materials, Dr. Schumann states that the specific gravity of genuine pure Portland cement never sinks below 3.11, whereas, out of seventeen adulterated cements examined by him, not one attained to this amount. Many plans were presented to the authorities for ascertaining the presence of ground slag, both quantitatively and qualitatively, but they deemed it expedient to withhold their publication, as if simple means were pointed out for indicating the existence of this class of adulterants, fraudulent manufacturers would merely be induced to seek for other materials for sophisticaition. It came to the knowledge of the meeting that adulteration was not only undertaken by the manufacturers, but that the middlemen and dealers were also answerable for this practice, and that in some cases samples of cement had been met with which contained no less than 50 per cent. of foreign ingredients. As the result of the debate, the following six articles were adopted by the meeting:

1. Portland cement is a material resulting from an intimate admixture of lime and clay, as its essential components, calcined to incipient vitrification and reduced to a fine powder.

2. Every product formed in a different way, or to which foreign ingredients are added during or after the calcination, it is not to be considered as Portland cement. This is not, however, to exclude the addition of not more than 2 per cent. of Plaster of Paris.

3. The sale of cements, containing an admixture of foreign materials, under the designation of Portland cement is, therefore, to be considered as a fraud on the consumer.

4. Good Portland cement is not improved by the admixture of foreign ingredients; as, for instance, silicates of lime (powdered blast-furnace slag, etc.), trass, ground clay-shales, limestone, etc.

But even if, in certain cases, it were possible to adduce results showing that an improvement could be effected by such mixtures, the manufacturer is not to be allowed to adopt them, because the consumer has no means of so far checking the amount and the quality of such additions as to be able to protect himself against abuses.

5. Every addition to the cement is to be regarded as the commencement of its employment for mortar, and can, therefore, never be considered to be the business of the manufacturer, but must be undertaken by the consumer.

6. As the normal test, at the period when it was adopted, was introduced for the testing of Portland cement, unmixed with foreign ingredients, and, as the specific character of Portland cement is changed by such mixtures, the normal tests cannot be employed for the comparison of adulterated with unmixed or pure cements.

* From the *Transactions* of the German Association of Cement Makers, published in *Abstracts of Papers in Foreign Transactions, etc.*, issued by the Institution of Civil Engineers.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E. : M. INST. C. E.

(*Continued from page 583*)

DLXXVIII.—CONNELLSVILLE, PA.

Connellsville, Pennsylvania, in lat. 40° 7′ N. long. 79°-42′ W. is on undulating ground on the Youghiogheny river. In the neighborhood of extensive bituminous coal mines, its principal industry is the manufacture of coke.

Waterworks were built in 1883 by a private company after plans of Adam Miller and C. W. Knight, taking the supply by gravity from an impounding reservoir on a small stream, a mile from the town and 75 to 280 feet above it. The reservoir is formed by an earthen dam across a ravine and holds 5,000,000 gallons. When the stream is muddy, the water is diverted above the reservoir and passes around it. A two-inch cast-iron pipe conveys the water to the town and it is distributed by five miles of cast-iron pipes of 8 to 4 inches diameter, with 57 fire hydrants, 34 gates and 50 taps. The town pays a fixed sum for each hydrant, but the amount is not stated. Service pipes are of lead. The population in 1880 was 3,609, the works cost $50,000. James S. Kuhn is president and W. S. Kuhn, Secretary and Treasurer.

DLXXIX.—COUNCIL BLUFFS, IA.

Council Bluffs, Ia., in lat. 41° 15′ N. long. 95° 55′ W. is on the Missouri River at the mouth of Indian Creek and opposite Omaha. The city which was settled in 1850, is built principally on a plane at the base of high bluffs, with many residences on the bluffs and numerous ravines intersecting them. Water-works were built by a private company in 1883, after plans of H. P. M. Birkinbine, C. E., taking the supply from the Missouri River. A conduit of oak lumber, 3x4 feet in dimensions and 2300 feet long conveys the water across a bar of quicksand to a pump well, where it is pumped by two Andrews centrifugal pumps driven by Westinghouse engines, into two subsiding reservoirs, each of five million gallons capacity. After subsidence, it is pumped 215 feet by two Knowles duplex pumps, of 30 inch steam and 24 inch water cylinders, of 16 inch stroke, into a reservoir of 4,000,000 gallons capacity on the bluff. The ordinary pressure in the mains is 69 lbs. and it is arranged to apply to a fire pressure of 125 lbs. Distribution is by 22½ miles of cast iron pipe of 30 to 4 inch diameter, with 200 fire hydrants and 105 gates. The city pays $100 per year for each hydrant. Service pipes are of lead.

The population in 1880 was 18,059. The capital stock of the company is $750,000. George F. Wright is the Vice President and Harry Birkinbine the Chief Engineer.

During a single week the boring-machine on the Birkenhead side of the Mersey tunnel excavated no fewer than 32 yards, or 4 or 5 yards more than any previous week. Some days previous the centre of the bed of the river was passed. The progress on both sides has been such as now to reduce the distance to be bored to something under 200 yards.

Some one in France has taken the trouble to compute the statistical probability of the superstition that if 13 sit down to table one of them will die within the following year. From this competation it appears that if the average age of the company is 10 years there ought to be 144 persons present instead of 13 to make death probable; that if the average age is 15 years there ought to be 131; 20, 129; 25, 124; 30, 119; 35, 112; 40, 103; 45, 90; 50, 73; 55, 54; 60, 35; 65, 25; 70, 17; 72½, 13.

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Fifth Annual Meeting of the Michigan Association of Surveyors and Engineers.

PROGRAMME.

The meetings will be held in the Council Rooms, in East Saginaw, Mich., January 1st, 2d, 3d, and 4th, 1884, commencing at 2 p. m., January 1st with an address of welcome by the Mayor of East Saginaw, followed by address of the President of the Association, Prof. J. B. Davis, after which Reports of Committees, and of the Secretary and Treasurer will be read.

The following papers will be read during the convention:

Drainage of Large Marshes, by C. E. Hollister, Laingsburg.

Railroad Earthwork, by Prof. J. B. Davis.

Earthwork, by Wm. B. Sears, Ch. Eng. F. & P. M. R. R.

Logging Railroads, by H. M. Caukin, Greenville, Mich.

The Narrow Gauge Railroad, by A. L. Reed, Ch. Eng. P. H. & N. W. R. R.

Questions of Practice, by I. H. Leavenworth, Saginaw City.

Temporary Railroad Bridges, by Geo. Masson, Ch. Eng. D., G. H. & M. R. R.

Water-Works for Western Cities, by W. R. Coats, Engineer Kalamazoo Water-Works.

Legislative Questions—Form of Bill Needed, by A. L. Drew, Three Oaks, Mich.

Mechanical Engineering, by Prof. M. E. Cooley, Mich. University.

Report of Committee on Instruments.

Address by Geo. H. Frost, of ENGINEERING NEWS, New York.

There will be a Reception and Banquet on the evening of Thursday, January 3, and an Excursion to points of interest in Saginaw and possibly Bay City, on Friday, the 4th.

There will be a very fine exhibit of Surveying Instruments, by manufacturers, and the Executive Committee has especially requested members to add to this exhibit by bringing those used by them to the Convention.

Arrangements for Transportation have been made whereby members paying full fare in going to E. Saginaw, will be returned at one-third rates.

The Headquarters of the Association will be at the Marshall House, where reduced rates will be allowed to visiting members.

The Secretary of the Association is Prof. R. C. Carpenter, Agricultural College, Lansing, Mich.

We very rarely, if ever, hear of trouble on railroad work arising from "unbalanced bids." The reasons are simple enough, for the classification of "probable quantities" is generally in the hands of an honest and experienced engineer; and in the tabulation of bids any figures as wild as those given by New York contractors for city work, would consign the proposal containing them to the waste basket.

The railroad official is a man selected for his intelligence, experience and probity, and it is expected that he will stand guard over the financial interests of the Company he represents. He has the power to reject any and all bids, and would make short work of a proposal to remove rock at one-quarter of a cent per yard, and the generous offer of $8 per yard for earth excavation.

A little of the same sound policy in the selection of men, and a great deal less attention paid to the political status or influence of the individual official, would go far in insuring our municipalities from the waste of public money now chargeable to ignorance and fraud.

Other cities than New York have suffered in a similar manner but unlike New York, official corruption has been generally followed by a popular revolution that has resulted in more honest government. Position and politics have been so intimately mixed here, that the place holder's acquirements as a "worker" outweigh all considerations of fitness for the office with which he is rewarded. And as the honest, law-abiding citizen is rarely the influential man in his ward, we must accept the bad official with the "good" politician, if we permit a system of city government, which invites corruption by making use of corrupt men.

The result is inevitable, and while it is altogether too Utopian to expect that a city can be ruled in all its diversified branches, with the same faithful and strict attention to men and details that characterises a private corporation business, the nearer we approach that model the less cause there will be for complaint. And a first step in the right direction is to make fitness, and not ward politics, the recommendation for an office. In the *Tribune* expose, it is shown that a number of the surveyors and contractors engaged in the profitable works mentioned, have descended to us from that King of Bosses, Tweed himself. They are probably still suffering from that same old complaint; time has made it chronic, and they could not be honest if they would.

The only question which interests the public, is how do these individuals retain their strong grip upon the City's treasury? To judge men from their deeds, they are certainly not useful for their many virtues; and if it is their proficiency in rascality that is being rewarded, their masters must expect to suffer with them when the day of judgment comes.

The profession of Engineering has for years been subdivided into many allied branches; we have had Civil, Mechanical, Mining, Hydraulic, and Sanitary Engineers; of late years the Agricultural and Irrigation Engineer has been added to the list. But the end is not yet, and the division goes on; in a late Manchester, (England) paper, we notice the advertisment of a firm of "Laundry Engineers" who promise to design and erect all the steam-fittings, tubs, boilers, etc., supposed to be needed in such an establishment. And last of all one of our exchanges mentions that a Mr. Mercer, lately connected with the Iron Mountain and Texas Pacific railroads, has been appointed "Travelling Engineer." What his special duties are we must leave our readers to guess for themselves; we know not.

The new astronomical observatory at Nice, one of the finest in Europe, is almost completed. M. Perrotin, the French astronomer, who conducted the transit of Venus expedition to Patagonia, is in charge and has already commenced the work of observations.

This observatory, which when completed will cost $600,000, is the gift of M. Bischoffsheim of Paris. The smaller equatorial instrument is seven metres in length and the objective is 18.38 centimetres in diameter; the cupola is of wood and copper. The large equatorial, not yet completed, will cost $70,000, it will be 18 metres in length, with an object glass 76 centimetres in diameter. The cupola over this large instrument will be floated in a circular tank of water, and will thus revolve more easily than if it moved on wheels; in the four corners of the square building containing this telescope will be wells, one of them thirty metres deep, where observations of the temperature of the earth can be taken, and other experiments made.

The defective drainage of the Batavia (N. Y.) Institution for the Blind, as lately exposed after the death of several of its inmates from malignant diptheria, illustrates both the methods too often in use in similar institutions, and the results that may be expected to follow the neglect of intelligent care in the selection and arrangement of the house fittings.

As showing how badly a thing can be done we give the result of an examination by a sanitary engineer, as reported by the *N. Y. Times*.

The sewage is and has been since the building was erected, deposited in a swamp back of the institution. Three large pipes leave the building at different points, but all converge and empty into a large concrete drain several rods back. Six-inch tiles are laid in the corriridors in the basement and lead into the main sewer-pipes. Pipes leading from the bath-rooms, lavatories, etc., above empty into the tile drain. It was discovered that the drain in the basement was in a wretched condition and that it had at some time been improperly repaired. Several lengths of the tile had been broken and had been repaired by pieces of tin, which had been carelessly laid over the breaks. Earth had been piled around them and had gradually found its way into the tile. Some of it had been washed away, while some of it clung to the tile and accumulated until there was sufficient to clog the flow of sewage. The result was that waste matter lined length after length of the tiles and the sewage escaped on account of the clogging and impregnated the surrounding soil. The waste matter decomposed and noxious stenches and poisonous gases containing the germs of disease arose and could find no other outlet than the bath-rooms, lavatories, etc., which were daily used by the inmates of the institution.

Had not the difficulty been found in defective sanitary arrangements in the building, it would have been met with in the large drain outside leading to the swamp. The drain was of concrete which had fallen to pieces, and the earth had caved in, blocking the passage of water and sewage and backing them up so that the source of the poisonous gases was doubly accounted for. Now, however, under the direction of the representative of the State Board of Health, an entire new system of sewerage is being put into the building to replace the old. All the old pipes and appliances that were at all likely to be contaminated have been removed, and to take their place new and improved water arrangements, with pipes properly tapped, have been introduced.

Outside, the sewer pipes have also received careful inspection and attention, and the old decayed concrete drains have been taken up and vitrified tile laid down. For the present the sewage is emptied into the swamp as heretofore, but it is considered impracticable to continue the deposit there longer than during the cold weather, and before spring opens some means will be decided upon for better drainage facilities.

We reprint, this week, from the London *Contract Journal*, the specifications for a sea-water supply. They contain a number of conditions novel to American engineers, but worth consideration. Sections 33 and 34, requiring the contractor to set out the work according to the plans and sections, and holding the same contractor responsible for errors in the plans and sections, are rather startling innovations on this side of the Atlantic.

The different classes are lengthy, but, we think, clearly express their meaning, a most desirable feature in specifications and contracts, and one not always attained.

MR. OCTAVE CHANUTE, acknowledged to be foremost in rank as a railway engineer, has been talking sewerage (according to Waring) to the people of Kansas City. Mr. Chanute estimates a saving to Kansas City in sewering on the Waring plan over the old time combination system, of $1,900,000, as nothing is said about royalties on the Waring patents, we do not know whether this item of annual charges on the Waring system is included or not. We notice that the Mayor has "made up his mind" that the Waring plan is the best for Kansas City, while City Engineer Knight, who, like Mr. Chanute, is a member of the American Society of Civil Engineers, and who is presumably familiar with the topography of Kansas City, has, after two visits to Memphis, advised against the adoption of the Waring system.

We recommend R. Hering's report on Philadelphia sewerage to the people of Kansas City: where a combination system is evidently the proper one, as in main business streets—adopt it, and in outlying territory where population is scant and topography favorable—adopt Waring's supposably cheap system, with its small pipes, surface drainage and patent flushing tanks.

Michigan Association of Surveyors and Engineers.

This flourishing Association will hold its Fifth Annual Meeting at E. Saginaw, Mich., Jan. 1 to 4 inclusive The time of meeting was considerately arranged so as not to conflict with the meetings of similar associations in the adjoining states of Ohio and Indiana, and that of the American Society of Civil Engineers, in New York, all of which are appointed for the early part of the month. The programme at E. Saginaw, in its attractiveness over that of proceeding years, shows the social influences that are at work on the solitary predilections of surveyors. In addition to the regular programme of papers, business and exhibits of surveying instruments, a banquet and an excursion are projected. We are pleased to know thst the association was never in a more healthy condition financially and otherwise than now. Its membership is already nearly 150 and there will be a large accession at the next meeting. Most of the prominent engineers of the state belong, and several applications for membership have been received from other states,

Many of its members also belong to other societies, Prof. J. B. Davis, President of the association and Prof. C. E, Greene, belong to the American Society of Civil Engineers; Prof. R. C. Carpenter, to the American Society of Mechanical Engineers; J. J. McVean, Chief Engineer, D. L. & R. R. to the Western Society of Civil Engineers.

The following railroad engineers are members of the Society, Wm. B. Sears and Geo. M. Brown, of the F. & P. M. R. R.; C. H V. Caris of the M. H. & O. R. R.; J. J. McVean, of the D. L. & N. R. R.; Geo. Masson, of the D. G. H. & M. R. R.; A. Gardiner, Oregon R. R. & T. Co.; J. P. Greene, of the P. O. & P. A. R. R.; Wm. P. Innes, State Railroad Commissioner; A. L. Reed, of the P. H. & N. W. R. R.; C. Woodard, of the O. & B. R. R. R.

PHILADELPHIA BRIDGES.

When other matters fail them it seems to be the proper thing among the reporters of the Philadelphia press to interview a citizen expert upon the stability and probable lifetime of some one of the city bridges over the Schuylkill.

Just now it is the Chestnut street bridge that is again interesting them. This is an arched structure, and the western abutment, unable to resist the horizontal thrust against it, is gradually yielding, and to such a degree has this action already taken place that the entire structure threatens to follow the example of its neighbor, the South Street Bridge, the western arched approach of which tumbled down some years ago.

The trouble seems to lie in the deep alluvial deposit which forms the west bank of the Schuylkill River; and in both cases, the building of very excellent masonry arches upon long piles driven into a mud which in itself is uncertain in its composition, and cannot resist any lateral motion in the piles. The Chestnut Street Bridge was commenced about the date of the outbreak of our civil war, upon peace estimates and peace contracts. The abrupt and rapid rise in the price of material probably had much to do with the doubtful pile foundation adopted. And the result is that which usually follows when structural conditions are too heavily discounted, and the hidden substructure is sacrificed so that a more generous portion of the appropriations may be reserved for the superstructure, the part which catches the eye of the admiring public.

Philadelphia has been especially unfortunate in her Schuylkill bridges; but after the failure of two arched structures she now contemplates trying a third in the same locality, and that under conditions of mass, span and rise that make the experiment an exceedingly risky one. Will the authorities profit by the experience of the past?

It has been decided by the engineering experts of the Councils of the city of Philadelphia—and they unaided, seem to have settled the matter among themselves—to make the new Market street bridge a stone arched structure, 100 feet wide. The dimensions proposed upon which bids are now asked, are as follows: one central arch 123 ft. span, with a rise of 20½ ft; two side spans of 117⅛ ft. each and rise of 19⅝ ft.; and two end spans of 50 ft. each, with a rise of 18⅛ ft. The piers at either end of the central arch have a width at the springing line of 14 ft. and a base of 27 ft. at the bottom of the foundations, total height of piers unknown. The piers at the ends of the 117 ft. spans are "abutment piers" and the western pier is 20 ft. thick at the spring and 44 ft. thick at the base, with a total height from base to springing line of about 60 ft. The end abutments are only 9 ft. wide at springing-line, and the western one has a total height of about 62 ft. and a base of 25 ft.; and it is backed by that very soil the treacherous nature of which has been already well demonstrated. It will thus be seen that the "abutment piers" must really do all the work thrown upon them by the flat main arches.

We have not investigated for ourselves the matter of thrust, but from a mere reading of the description we fear that the factor of safety as against overturning must be very small, in the west "abutment pier;" the "line of thrust" certainly can not fall "well within the base" as the doctors recommend.

In the matter of foundation material, concrete is required. The specifications say that "no concrete shall be laid under the water." As this will necessitate a water-tight cofferdam, subjected to a bottom pressure of about 3,000 pounds to the square foot,—a structure expensive to build and keep tight—we do not understand why good stone masonry was not adopted; for, with all due respect to concrete, we would prefer stone under the conditions of the case. And furthermore concrete, well made, of good material and conscienciously put in place, will cost almost if not quite as much as would the Conshohocken stone prescribed for other portions of the work.

FRAUDS IN N. Y. CITY CONTRACTS.

The *N. Y. Tribune* of Dec. 9 and 10 exposes a most glaring series of frauds in the letting of contracts for city improvements, and makes a vigorous attack upon the methods by which this plundering is made possible.

The system of stealing just brought to light, is one long known and successfully practiced in the days of the Erie Canal ring. It is that of *unbalanced bids*, another name for false or misleading estimates of probable quantities, made by the parties entrusted with that work. For example, if the earth excavation be really large in amount and the rock excavation small, in any proposed work, the amounts are reversed, and bids solicited upon this false statement.

With estimates so manipulated, a contractor in the secret, can always underbid his unposted rival by putting a merely nominal price upon the rock work and a correspondingly heavy price upon the earth excavations; in the tabulation of bids he will appear as the lowest and best bidder and secure the contract.

The *Tribune* illustrates this peculiar method of letting public works by a number of actual cases taken from the books of the Department of Public Works, and shows that some of the most corrupt instances belong to work now in progress. One example will suffice for all; it is a contract made on July 31, 1883 for the regulation and grading of a portion of 95th Street. In this case the estimate of "probable quantities" called for 1930 cu. yards of earth excavation and 21,540 cu. yards of rock excavation. Out of nine bids given, five parties bid the following prices for earth excavation per cu. yard: $8.00, $11.00, $12.00, $13.50, $13.95; and for the rock the same parties bid, in the order named above, $0.00¼, $0.00½, $0.10, $0.01 and $0.01. The proposal accepted was the one giving $8.00 for earth and $0.00¼ per yard for rock, and figuring upon the classification given the total contract was to cost the city about $16.000. To the date of the *Tribune's* examination this lucky contractor had drawn from the City Treasury $60,000 and had so far removed only 1,000 cu. yards of rock. Competent authorities estimate that the excavation will really contain over 14,000 cu. yards of *earth*, and that the city will ultimately pay about $112,000 for a piece of work worth at fair prices about $5,450.

The wide margin between the estimated cost of doing the most ordinary class of contract work, as exhibited in the bids of these New York contractors, is difficult of explanation upon any honest basis; and it won't do to charge all the vagaries of the engineers estimates to "errors" of judgment; the mistakes are somewhat too systematic. We have been told that with other work on hand, the fortunate bidders possessed advantages that enabled them to make the anomolous proposals quoted. We do not doubt for a moment that the five bidders for the 95th Street work did possess certain advantages; but we fear these advantages were, a certain knowledge of the "error" of the estimating engineer, and a consciousness that the little mistake would be rectified after the letting of the contract; in other words there was collusion between the engineer and the contractors. This is an ugly accusation to make but one warranted by the facts in the case.

Commissioner Thompson in a letter to the *Tribune* treats the matter lightly, exhibits a statement, in two lines of figures, showing a total loss from "unbalanced bids" of only about $45,000 in three years, and says that the mistakes in classification are due to a lack of funds for making the proper preliminary examinations; and finally, that the law compels him to pay the figures offered by the lowest bidders.

As the *Tribune* exhibits one contract in which the loss is $110,000 over and above the original nominal bid, the figures of Mr. Thompson evidently need revision. As to errors in classification, we can only say that an engineer who will reverse the figures in classifying 22,000 yards of earth and 1,000 yards of rock, is either too ignorant or too dishonest to hold his position. A vacancy in the engineering department would soon follow such an outrageous "lack of judgment" on railroad work. As to the law in the matter, the Commissioner has the option of rejecting all bids, or only accepting "the lowest and *best* bidder." The figures given as the prices of doing work, the value of which is well known, would be ridiculous were they not so plainly fraudulent. Such a bid would justify any official in rejecting it altogether. Fraud is stamped upon its face, and the parties accepting it must also accept the condemnation of the public.

The *Tribune* mentions by name the many knowing contractors, but fails to name the parties who, in our opinion, are at the bottom of the mischief. We refer to the engineers or surveyors who make the estimates. If, to put the most charitable construction upon their work, they are too ignorant to make even a shrewd guess at the actual quantities they should be removed. If they purposely err in their statements, so that they may sell their guilty knowledge, they should be punished. In either case they disgrace the worthy profession to which they professedly belong. If they *can* explain the results of their estimates, it is high time to do so.

In the meantime the *Tribune* promises further developments; and these, as in the surface measurements of street paving, under conditions that no lack of "boring tools" will explain. In the interest of all honest engineers and contractors we wish the *Tribune* "good speed" in its crusade.

THE METRIC SYSTEM ON LAND PLANS.

By general legislation and organized and rigid inspection, England is preventing the further use of many old local and customary weights and measures formerly in vogue, and is compelling the use of the few imperial units, which have fixed though irregular relations to one another. She has only one pound, only one ton, only one capacity measure for both liquid and dry substances, with a gallon holding ten pounds of water and a bushel eighty pounds, though metric terms may be used in contracts, and metric weights and measures for the purpose of science or of manufacture.

Most other civilized nations have forbidden the use of the old medley of weights and measures which in them, as in England, was formerly marvelously irregular, and have required the substitution of the metric system, which is pre-eminently simple and uniform. Continental Europe, generally speaking, has carried such legislation into effect. Central and South America, generally speaking, have not yet succeeded in enforcing their legislation among the more ignorant portion of their inhabitants, so that at present both the metric and the ancient denominations (mostly of Spanish origin) are still in inharmonious use.

What are we doing? Judging from our legislation the United States alone among advanced nations, might be presumed not to know that several sets of weights and measures confused together are worse than one system exclusively used would be, even if that system were comparatively a poor one. As a natural consequence of the way the country was settled, weights and measures of English origin came into use in the eastern and older states, those of French origin in the Louisiana purchase, and those of Spanish origin in Texas, California and other territory acquired from Mexico;

but those old units differ from what are now used in England, France, Spain and Mexico. The states of the Union have made their own laws at variance with one another. One has 2,000 pounds in a ton; another requires 2,240. In one State four quarts of milk are 231 cubic inches, in an adjoining State 282, and in both four quarts of grain have a bulk different from either. The bushel of barley and the bushel of oats have each six or eight different legal weights in the several States and Territories. A bushel of coal mined in the State of Indiana is fixed at seventy pounds, but a bushel mined outside the State and sold within the State must contain eighty pounds. Local legislation has been permitted, because the United States Congress has almost entirely abstained from exercising the power to "fix the standard of weights and measures" expressly granted it by the Constitution. About fifty years ago the General Government provided uniform standards for its own custom houses, where it was found that seriously discordant standards had been in use; but it still allowed the avoirdupois pound to be heavier than the troy pound, while the avoirdupois ounce was lighter than the troy ounce; and it still allowed the dry bushel of 2150.42 cubic inches to bear no relation to the liquid gallon holding 58372.1754 grains of water.

In 1866 Congress legalized the metric system, which has now come into practical use among scientific men, chemists, apothecaries, physicians, opticians, surveyors, the United States mint, post-office, etc.; but the simultaneous use of the ancient units is still allowed. The Congressional Committee which recommended this enactment hoped that it might be followed in due season by a law requiring the exclusive use of the metric system.

To add to the variety, the surveying profession has insisted on decimal measures of its own regardless of the units in general use, which did not have decimal relations. Two or three centuries ago, Gunter devised his chain of one-tenth of a furlong divided into 100 links; the square chain was one-tenth of an acre. This continues to be used very much in England and in the United States public land surveys; but it bears an awkward relation to the more common measures, as one inch=7.92 inches, one foot=1$\frac{1}{2}\frac{9}{5}$ links, one yard=4$\frac{8}{11}$ links, one square chain=484 square yards; in connection with it we have such inconvenient scales for plans as $\frac{1}{1584}$, $\frac{1}{2376}$ and $\frac{1}{4752}$.

Another surveyors' device was to divide the foot into hundredths and adopt a tape or chain of 100 ft.; this is necessarily at variance with every old measure except the foot. The hundredth of foot is four per cent. less than an eighth of an inch; the inch is 0.083$\frac{1}{3}$ ft.; the 100 ft. tape or chain is 33$\frac{1}{3}$ yards and not convenient for exact comparison with a standard yard; the furlong is 6$\frac{2}{3}$ times 100 ft.; the mile, eighty feet more than fifty-two times; the perch of land or square rod is 272.25 square feet; and the acre, 43,560 sq. ft. In connection with this surveyors use such scales as $\frac{1}{100}$, $\frac{1}{300}$ and $\frac{1}{700}$. This practice is different from that of architects and from that of engineering construction in wood, stone and iron. Though it has been used by American railway and land surveyors for forty years or so, it has made no progress towards adoption by the rest of the community excepting some earth-work contractors.

As an illustration of the present state of things, we find in a single New Orleans newspaper among the descriptions in advertisements of real estate, feet, inches, and lines of American measure, French measure and English measure, eighths of an inch, arpents, acres, and miles.

It is not to be supposed that the United States will be permanently classed with Asia and Africa, and will long tolerate a confusion in weights and measures unparalleled among the leading nations. The spirit of the present age tends unmistakably toward uniformity, and it is time that intelligent people concerned with land measurement should open their eyes to the fact that by and by only one system is going to be in use. The general adoption of the metric system would secure for surveyors the same decimal advantage that they have hitherto gained by their peculiar devices, and would also yield the advantage of uniformity with what would be used in engineering construction, architecture, and everything else. As land plans are apt to be recorded or preserved for use long subsequent, there is especial reason why they should now be prepared in conformity to the system of the future. At the least, every plan of importance enough to bear a line or scale ought to have a metric linear scale in addition to whatever other may be required. It would be still better if plans intended for preservation should be plotted on scales that can be expressed as decimal fractions, like .001, .0005, .0002 of natural size. This is appropriate to a decimal system, and equally adapted to all completely decimal systems, whatever length be taken as the base. If one hundredth of a foot represents 1,000 ft., one centimeter represents one kilometer. Some surveyors already measure in meters; and in such work as is sufficiently disconnected from other measurements to escape immediate inconvenience, it is very desirable that others should do likewise. Take, for instance, the measurement of areas and the making of plans and descriptions for deeds of record in places where the work has not already been commenced in another system, and where construction is not to follow directly after. The metric system should be adopted as rapidly as possible in the United States public land business. The sooner that is accomplished the less of our territory will be subjected to the inconvenience of having its dimensions translated when it comes to be developed hereafter.

The New Jersey and the Central Tunnel Co's.

The purpose of the first named company is the building of a tunnel under the North River from Communipaw to some point on the lower end of Manhattan Island. The tunnel will be driven through the rock which the engineers hope to find favorably located for such purpose, and in length from shore to shore it will be about one mile long. Mr. John Schuyler, late Chf. Eng., of the New Haven R. R. is now engaged in making the preliminary investigations. He estimates the cost of tunnel portion at $100 per lineal foot; and the half-mile tunnel approaches at either end at $1,000,000; the total cost including depots, rolling stock and superstructure is put down at $3,000,000.

The Central Tunnel Co., which was organized two years ago, with a capital of $5,000,000, is to connect with the North River Tunnel, and, following the back-bone of the island, is to tunnel from the post-office building to 42nd St., there connecting with the tracks of the Grand Central Station. The President of the Central Co., is Gen. John Cochrane; Wm. E. Worthen is the Vice President; Henry H. Stetson, Treasurer; and Wm. Kent, Secretary; W. C. Nicoll, Gouverneur Tillottson, Spencer D. Schuyler, Stephen O. Lockwood, Eugene Schieffelin, C. B. Meserole and O. P. Pell are among the directors. These same gentlemen are also identified with the Jersey Tunnel Co.

The *N. Y. Times* gives the following outline of the route and design of the Central Company's tunnel:—

The legislative grant was obtained in 1881. It authorized the company to erect its tunnel from Forty-second street down Fourth avenue, through Lafayette-place, and down Elm street and under the city hall park to the post-office. The distance is three miles. The estimated cost is about $1,000,000 per mile. The plans propose a double track tunnel of brick of 26 feet in width, and averaging 20 feet in height. Beginning at Forty-second street it will be a double tunnel extending down the avenue on either side of the present horse-car tunnel and far below its level, and uniting somewhere near Thirty-fourth street, The level is such that a continuation of the tunnel to the north would connect it with the four-track railroad tunnel at about Fifty-seventh street. Running below Fourth-avenue to the south no obstructions would be offered to the surface traffic, Mr. Schuyler says, other than here and there a grating to serve as ventilators. In conjunction with the plan to tunnel Elm street is the plan to extend, widen, and grade that street so as to form a broad thoroughfare from Lafayette-place to the entrance of the bridge, one of whose results will be a relief to traffic on Broadway. The scheme further contemplates the opening of the centre of that thoroughfare at intervals for the purpose of lighting and ventilating the tunnel, just as was done in building the Fourth avenue horse car tunnel.

The Arlberg Tunnel.

(Translated for ENGINEERING NEWS from *Le Genie Civil.*

The Arlberg Tunnel, inaugurated on November 19, is 33,685 ft. long, that is to say, after the St. Gothard which measures 48,872 ft., and the Mont Cenis with its 40,446 ft., it is the longest tunnel now existing. It eclipses all others, however, in the comparative rapidity with which it has been driven. The Mont Cenis Tunnel practically required more than fourteen years of work, the St. Gothard, nine and one-half years, and the Arlberg only three years and five months.

According to the *Moniteur des interests Materiels*, the Austrian Government had for a long time past desired to emancipate two great portions of the Empire from their dependence for transit upon Germany and Italy, for all exports towards France and Switzerland. Several propositions pointing toward this end were submitted to the legislature in 1872 and in 1875; but it was only in March, 1880, that the project was definitely decided upon.

A railway was first constructed 73 kilometres long, now open to travel, between Inspruck and Landeck. From the latter place the road traverses the banks of the river Inn, so as to reach the mountain called Arlberg, near the village of St. Antoine, 100 kilometres from Inspruck. At this point the tunnel commences, rising gradually in a distance of 13,455 ft. to an elevation of 4,297 ft. above the sea (603$\frac{1}{2}$ ft. higher than the St. Gothard tunnel), and then descends toward Langen, situated 33,620 ft. from St. Antoine. Upon one section the grade reaches 28 per cent. From St. Antoine the line stretches out towards Bludenz, to unite with the Voralberg Railway, connecting at Lindau with the Bavarian system, and also at Buschs and at St. Marguerite with the railway system of the Swiss Confederation. The total length of the Arlberg Railway reaches 1,366 kilometres (860$\frac{1}{2}$ miles), of which 147 kilometres are between Inspruck and Bludenz. The entire line will not be finished for about a year; the entire cost of the work was estimated at $17,800,000, of which $8,100,000 was expended upon the tunnel, makingthat work cost per lineal foot, $240.47.

It was originally expected that the tunnel would be finished about February, 1885, the actual result has exceeded the most sanguine anticipations.

On June 14, 1880, the first stroke of the pick was made. Ten days after that date the actual work of driving the tunnel was commenced, at first, by hand; the boring machines were not in use, until the middle of November, 1880.

The two companies who were engaged in this enterprise, each applied a different system of machine drilling. The Ceconi Company (east side) equipped their section with the Ferroux percussion drills, the same as used at the St. Gothard tunnel. The Lapp Bros. (west side) employed the rotative hydraulic drill of Brandt, an Austrian engineer.

The Ferroux drills drove a longer length of the tunnel than the Brandt machines; but the Lapp Bros. used only four machines, while the Ceconi Company had eight at work: moreover, on the west side, serious difficulties from bad material were encountered from the start. According to approximate calculations the Ferroux drills drove 18,100 ft., and the Brandt drills, 15,416 ft.

The material removed by the drills reached the amount of 1,333 cu. yards in twenty-four hours; and about 670 cu. yards of stone, etc., had to be brought daily into the tunnel for the masonry. One million seven hundred and sixty thousand pounds of dynamite were used.

The number of workmen employed on the east side during the first six months, was from 250 to 700; tne next year, from 1,041 to 1,453; in the last working months, about 2,000. On the west side the number of laborers varied, for the first year, from 241 to 986; in the second year, from 1,000 to 1,450; in the third, about 1,900; and at the close of the work the number reached 2,800.

This gigantic undertaking is not the only interesting piece of work upon the Arlberg Railway. The two sections of the line abutting upon the tunnel; that is, from Landeck to St. Antoine, and from Bludenz to Langen, have upon them some remarkable specimens of engineering art: a number of small tunnels, viaducts, bridges and aqueducts, protecting works against the descent of the avalanches, and thick retaining walls to resist the pressure of earth and snow. So also upon the section of Pians-Strengen, where can be seen a viaduct 197 ft. in length, a retaining wall 131 ft. high, a second viaduct with four arches from 33 ft. to 39½ ft. span, a wall 98⅓ ft. high, two other viaducts having seven and five arches, respectively, each with a clear span of 26½ ft.; and finally, a viaduct 623 ft. long, with seven spans, the center one crossing an opening of 393⅚ ft.

From an economical point of view, the end desired by the Austrian government in building this new line could not have been reached without the co-operation of Switzerland. By reason of its rates, the St. Gothard Railway would have been a formidable competitor, especially for all the trade between the East and Middle-Germany. With their local rates the Swiss companies would be enabled from the start to sensibly impede all traffic by way of the Arlberg. But on January 4, 1880, a convention was concluded between Austria, on the one part, and the government and the Swiss companies on the other, in virtue of which all tariff was conceded to the St. Gothard Railway for the traffic towards Switzerland and vice versa, while through freight was conceded to the Arlberg road.

The completion of this line will open the most direct and economical way for the exportation of the products of Austria-Hungary, Roumania, and from Russia in to France and Switzerland.

The distance between Trieste, Switzerland, South Germany and France will be reduced some 200 kilometres (124 miles.)

PERSONAL.

ANDREW CARNEGIE, the Allegheny county millionaire, proposes to build houses and sell them on easy terms to his employes in the Edgar Thomson Steel Works, and also to open a store in which they may get goods at cost.

CHARLES MACNAY commenced a libel suit on the 5th in the Circuit Court at Chicago against CHARLES H. NASH to recover $20,000 damages. The defendant is Chief Engineer of the Danville & St. Louis Railway Company, and MacNay was discharged. He sued for back salary, and now charges that Nash asserted that he was a good fellow, but incompetent as an engineer. This McNay claims was a slander. McNay is a son of the present Manager of the Stockton Railroad in England, the first railroad ever constructed.

Mr. A. GOTTLIEB, President and Chief Engineer of the Keystone Bridge Company was in this city on Tuesday last.

LEO DAFT, inventor of the electric motor which has just come into notice, was borne in England about 40 years ago, and was trained in science under the late Sir William Siemens. He lived in this country about 13 years.

AMONG those who are most celebrated for their after-dinner wit are Chauncey Depew, Gen. Horace Porter, Jos. H. Choate and Henry Ward Beecher. Depew is perhaps the most accomplished after-dinner talker we have. He is very quiet in his mannner. He speeks in subdued tones and solemnity sits upon his countenance. His features are perfectly impassive, and while he convulses the table, a deaf and dumb man might think to see him that he was making a funeral oration. Depew is a prominent half-breed Republican and he has a salary of $25,000 a year as the leading counsel of the New York Central railroad. Gen. Horace Porter is a practical railroad man and president of the new West Shore road. He has a pungent wit. His after dinner efforts perhaps smell a trifle of the lamp but their wit is keen and polished.

The Washington Monument as Compared with other Lofty Structures.

A reporter of *The Sun* relates the following experience in ascending to the top of the monument in the company of a learned mathematician among the other passengers:

The mathematician, as we stood at the base, explained tne nature of the trip. "We shall be," he said,, "nine minutes going up, or forty-five feet to the minute. We can thus easily determine as we go up the height of rival elevations."

"The first station on our perpendicular road is Pisa. Here we are: Leaning tower of Pisa, 179 feet."

"Here are a group of stations. You will be obliged to look quick as we pass to see them at all: Montreal—Notre Dame cathedral, 220; Bunker Hill monument, 221; Notre Dame de Paris, 224."

"Indeed," exclaimed the young ladies, after which silence settled on the group for another very long minute. The company began to be afraid that the savant had forgotten his notes or had tumbled off. But at the right instant his calm voice was heard again:

"Six minutes. We have just passed over the Marent trestle on the Northern Pacific, 266 feet and are at the minaret or the Great Cairo Mosque, 282. Almost directly opposite is Trinity spire, New York, 284. The tallest of the pagodas, the Pih-She-t'ah, at Soochow, is below us at about 250 feet. Now we are passing the campanile at Florence, 292, and here comes the top of the Capitol, 307 feet.

"Why, how very interesting," remarked the young ladies, clinging tighter than ever to the blocks of marble. There was a little shaking of the platform, and one of the blithe young men declared that it was caused by the trembling of the other young man, but this he denied with a painful effort at hilarity.

"Oh, we're almost there," exclaimed one of the ladies, looking up.

"Yes," replied one of the young men, glancing over the edge," but it's a deep hole down to the bottom." This was a most superfluous remark, and dispelled at once the cheerfulness of the group. The scientist alone was unmoved. Glancing at his card, he remarked:

"Eight minutes; Milan Cathedral, 355; the Shoemadoo pagoda at Pegu, 361; St. Paul's, 365; Hotelspde Ville, Brussels, 370; Lubeck Cadral, 395. Here we are, Antwerp Cathedral, 402; Washington monument at present, 410."

"Oh! oh!" exclaimed the young ladies, springing off the car and getting at once in the way of the workmen.

All were admiring the scenes below when the admiring exclamations were broken in upon by the calm voice of the Professor:

"There are still higher towers," he said, "such as the chimney of the chemical works at Glasgow and the great pyramid, each 450 feet; St. Peter's, 455; and the Cologne Cathedral, 511."

"Indeed!" exclaimed the young ladies, but their attention was now distracted by the beauties of nature and the statistics fell on deaf ears. They therefore turned their backs onthe mathematician and let the frivolous young men point out the various objects of interest while he retired from the edge and interrupted the busy superintendent to ascertain the distance of the horizon and the pressure of the monument per square foot on the base.

CORRESPONDENCE.

A HORIZONTAL WELL.

Special Correspondence Engineering News.

LYNN, MASS., Dec. 10, 1883.

EDITOR ENGINEERING NEWS.—In the "History of New Ipswich, N. H.," is the record of such a well as your correspondent "W." has in mind. I have not the book at hand, but, as I remember it, the well sloped upward from the hillside towards the centre of the hill, and the water ran out by gravity. Respectfully,

T. P. PERKINS.

MOVEABLE vs. FIXED CAR WHEELS.

Special Correspondence Engineering News.

LAKEVILLE, CT., Dec. 10, 1883.

EDITOR ENGINEERING NEWS.—In reply to your correspondent's inquiry on Moveable vs. Fixed Car Wheels, I would say loose wheel service has never yet given satisfaction on fast trains, probably because wheels when fastened on their axles revolve truer on high velocities by being companioned than if loose on their axles and uncompanioned. Respectfully,

WM. E. PETTEE.

GELATINE SENSITIVE PAPER.

Special Correspondence Engineering News.

CITY ENG. OFFICE, SOMERVILLE, MASS., Dec. 3, 1883.

EDITOR ENGINEERING NEWS.—Can you give me any information as to the "gelatine sensitive paper" mentioned in your latest issue? Can you tell me who makes it and what it costs? Respectfully,

THEO. P. PERKINS,
Assistant.

[The paper is manufactured by Messrs. E. & H. T. Anthony, 591 Broadway, New York, who will send samples, prices and particulars upon application. The paper is used in considerable quantities in the office of the *Scientific American*, from whom information as to its practical uses can readily be obtained. ED. ENG. NEWS.]

AUBURN, N. Y., SEWERAGE.

Special Correspondence Engineering News.

AUBURN, N. Y., Dec. 7, 1883.

EDITOR ENGINEERING NEWS.—Our city authorities are talking about a plan of sewerage for a portion of the city, and one of the difficulties to be met with is the storm-water drainage from a cemetery of about sixty-five acres, which flows down a steep hill (the cemetery being situated on high ground) in a large volume during a rainfall, after which the storm water channel would be dry. On account of the way the cemetery is laid out in roadways, etc., the water of storms flows off quickly. One of the Aldermen suggested the plan of a reservoir at the foot of the hill from which the water flows, to hold it back and let it off more slowly, and by that means save building a large sewer such as would otherwise be necessary. Sewers for the protection of private property are already built along a portion of the cemetery grounds near where the reservoir would have to be located. Can any of your readers tell me if such a plan has ever been tried, and if so, with what result?

Very truly,

J. L. BAKER,
City Surveyor.

RICH HILL, MO., WATER-WORKS.

Special Correspondence Engineering News.

322 PINE ST., ST. LOUIS, MO., Dec. 8, 1883.

EDITOR ENGINEERING NEWS.—I take pleasure in informing you that the Rich Hill Water-works have been completed and in service since several weeks after a fire-test, at which four 1" streams were thrown 150 feet horizontally under pressure of 80 to 82 lbs. at hydrants. The works are built under a franchise for 20 years, by a Company organized in St. Louis; the fire service begins with 50 hydrants at a rental of $500 annually. Total length of force main and distribution, 9 miles. Pipes, cast iron. Source of water, Marais des Cygnes River and subterranean water from a well of 25 feet diameter 44 feet deep. Engines, 2 Blake's duplex of 1,000,000 gallons capacity, each, with two tubular boilers 20 feet long. Pumping stations, fire-proof; contains dwelling of engineer above engine room. Distance of river from city limits, 2½ miles. System, direct pressure; at city limits closed standpipes (air vessel) of 40 feet height by 30" diameter.

City was started, plat recorded in June, 1880; has at present over 5,000 inhabitants, with the Lexington & Southern Branch of the Mo. Pac. R. R. going north and south and the K. C. Ft. Scott Gulf going east and west through the city, and the St. Louis, Emporia & Western under construction. The Company was formed and the work designed and built by Yours truly,

F. WM. RAEDER.

SELECTED MISCELLANY.

The great corporation composed of nearly all the gas companies in London, is by the largest concern of the kind in the world. It has a capital of nearly $65,000,000.

The weekly list of failures continues large and the number will probably increase till the opening of the new year. A large percentage of the embarrassments are among small traders, however; the weeding out has been too gradual to cause a panic, and general business will probably begin 1884 on a stronger and surer basis than for some time past.

In the nine years last past 541,196 people emigrated from Canada to the United States. In the last four years 401,260 came. The Marquis of Lorne, knowing this to be the case, is lecturing in England about the superiority of Canada to the United States as a field for English emigrants. The Marquis should be recalled to Canada to persuade the Canadians to stay at home.

William H. Vanderbilt owns $47,050,000 in United States registered four per cent. bonds, a draft for the interest of which is mailed to him quarterly from the Treasury Department. The interest on these bonds amounts as follows: Per annum, $1,882,000; per quarter, $470,500; per month, $156,883.33⅓; per day, $5,156.16; per hour, $214.84; per minute, $3.58; per second, .05⅞.

Sampson Fox, a great English inventor whose improvements in steamship boiler flues has made him wealthy, intends, it is said, to open an iron ship-yard on the Delaware, bringing over 1,000 men. He says the ocean steamships of the future will carry nothing but passengers and engines, and make the trip in four days. They will remain in port but a few hours and thus can make double or treble the number of trips of steamships carrying freight.

Senator John P. Jones, who is said to have lost $25,000,000 within the past ten years, is trying to get another fortune. He has leased the Bonanza mines from the 1,550 level upward. The Bonanza, which has turned out over $1,000,000 of gold and silver, was found at a depth of 1,550 feet, and Jones expects to find valuable ore deposits above that level. His lease extends three years, and he will explore the ground for all it is is worth. He is to account for 70 per cent. of the assay values of the ores found; all over that is to be his.

TURBATO.—Wood for fuel has another rival than coal, in Mexico. An article called turbato, consisting chiefly of bog peat, of which there are immense quantities, mixed with a proper proportion of bitumen, is extensively used for locomotives, stationery engines, smiths' fires, smelting, and household purposes. It burns freely, without much smoke, and gives a higher dynamic equivalent of heat than wood. The demand for fuel is increasing in Mexico, wood is growing scarce and advancing in value, and turbato, which is made and sold cheaper than either wood or coal, is advancing in popularity and general use.—*Northwestern Lumberman.*

The remains of the oldest bridge in the world, that built by Charlemagne over the Rhine near the close of the eighth century, have been met with by engineers at Mayence. It rested on 28 buttresses, and was evidently struck by lightning and burnt down to the level of the water. The engineers have been busy taking away its remains, and have already removed over 50 piles of five to six yards in length. The timber is well preserved, though nearly 1,100 years old: so well, indeed, that it is still fit for building purposes, while the iron, which was riveted to the posts, is also capable of being used, being covered by only a thin layer of rust.

A rich "find" of silver ore has recently been discovered in the right cheek of Mr. Emile Low, a well-known Pittsburgh, Pa. Civil Engineer. Unlike other deposits of silver ore, there are no doubts as to the origin and date of this one; it was the result of a dynamite explosion in a silver mine at Guanajuato, Mexico, in January, 1883. An annoying lump in his cheek, pronounced an "abrasion of the skin," by the surgeons, has now developed a piece of silver ore, of which Mr. Low has made a setting for a ring which he has presented to his wife as a memento of an interesting episode in his professional life. Mr. Low cannot estimate very correctly on the total amount of ore in his body.

The T rail, now universally used on American railroads, is generally supposed to be of English origin; but it was invented by Robert L. Stevens of Hoboken, N. J., in 1830, and was first laid on the Camden & Amboy Railroad. It did not come into general use until after 1845. The first made of these rails were only 16 feet in length. The first rails 30 feet in length were made at the Cambria Iron Works at Johnstown, Pa., in 1856, but there being no demand for them they were used on the tracks of that company at their works. The first 30-feet rails rolled on order were made at the Montour Works in 1859. The first 60-feet or double length rails, were rolled at the Edgar Thomson Steel Works, Pennsylvania, in 1875; and the company, in 1876, exhibited a steel rail at the Centennial Exhibition, 120 feet in length, weighing 62 pounds to the yard. The rail mills in the United States have now a capacity of 3,000,000 tons of iron and steel rails per annum. More than nine-tenths of the rails rolled in 1882 were of steel.

NEWS OF THE WEEK.

Railroads.

WORK has been completely suspended on the Orlando and Tavares, Florida, Railroad, after several miles have been graded at its Tavares extremity. It is alleged that the "Plant system has absorbed the Orlando extremity through Orange County, which will virtually put a stop to the building of the road.

A JOLIET special of December 3d, to the *Globe-Democrat* says: "A successful process for rolling rails at the works of the Joliet Steel Company, without reheating the ingots in the bloom furnaces, was put in operation to-day. Two hundred and fifty rails were run through direct from the shears; that is, they were taken from the converter direct to the bloom rolls, and instead of being taken from thence to the bloom furnaces they were put at once through the rolls, and finished without losing a rail or sending back a single bloom. It is said that the rails worked just as well and as easy as they do when reheated and taken from the bloom furnace. The process will be adopted, and will throw from thirty to forty heaters, chargers, buggymen and helpers out of employment, but this will be only a handful compared with the number that will be laid off when the new initial heat and soaking pit process is adopted. This will do away with both rail mill and bloom mill furnaces, and the hundred or more operatives that man them, also fifty or seventy-five others engaged in the two extra meltings and heatings.

THE GREEN MOUNTAIN RAILWAY runs from Eagle Lake to the top of Green Mountain (or Mount Desert Island) Me. The road-way is built on the solid ledge, to which stringers are bolted by 1¼" iron bolts six feet apart. When the stringers are above the surface there are bed ties six feet apart. On ledges, there are two and three 1¼" bolts back of each tie, into the ledge. All lengthwise timbers are bolted to the bed ties; the track ties are 6x6 inches, six feet long, and two feet between centres. They are grooved to prevent endwise sliding, and held to the stringers by two ⅞" bolts. The guage is 4 feet 7½"; T rails, fished, and spiked by two spikes in each end of every tie. There are cogs of 1¼" iron, held between two angle iron plates, secured to the ties by fourteen 5½" lag screws in every twelve feet section. When the locomotive sets in the forward gear, but is pulled backwards, down grade, the cylinder acts as an air compressor, pumping air into the boiler.

AT a recent meeting of the Board of Directors of the Norfolk and Western Railroad held in Alexandria the sum of $1,500,000 was appropriated for the building of the branch road from Martin's to Cripple Creek. The new road will be about fifty-five miles in length, and will run through a section rich in ores and dotted with many large furnaces in full blast, which will doubtless add greatly to the tonnage of the road, and cause besides the erection of many new ones. It is said that about eight miles of tunneling will have to be done. Contracts for rails, sills, labor, etc., will be given out at once.

IT IS stated that the Pennsylvania Railroad is seriously thinking of making a change in their main line from Harrisburg to Pittsburg, which will shorten the distance between those points at least fifty miles. This change is undoubtedly considered in lieu of its present winding course, to compete with its new air line rival now about commenced, the South Penn. Railroad. The proposed change is from Harrisburg over the Cumberland Valley Railroad to Chambersburg, then air line to Uniontown, connecting with the Southwest road and over it to Pittsburg. This new line is to be used for through travel, and the old for local and freight traffic. The Cumberland Valley Road is laying a number of long sidings between Harrisburg and Chambersburg; but whether this is being done in contemplation of the stated change, or for local improvement is somewhat of a mystery.

Certain it is that the Vanderbilt advent in that section of Pennsylvania is stirring the Pennsylvania and other roads to immediate action.

CHEYENNE, WY., December 9.—Articles of incorporation were filed yesterday by the Wyoming, Yellowstone Park and Pacific Railway Company. Among the incorporators are L. DuPont, the powder manufacturer, A. R. Converse, the President of the First National Bank of Cheyenne, and Governor Hale, of Wyoming. The road will run through the coal, iron, soda and petroleum region of Western Wyoming, in the National Park and Montana. Its construction will begin in the spring.

MR. JAMES ROSS, Manager of the North American Contracting Company, who have the contract for constructing the mountain section of the Canadian Pacific Railway, was in Toronto, Can., recently. In reply to a reporter of the *Mail*, he said: "The track is now at the summit of the Rocky Mountains, 123 miles west of Calgary. That will be as far as we shall go on in track-laying this year, but we shall not entirely suspend operations. During the winter our men will be employed in getting out timber and making ties, forwarding supplies, and arranging the stores for next season's work. We have five engineering parties at work engaged in revising the line of the route by the Kicking Horse Pass, and in making all the adjustments of it that are necessary, so as to be enabled to put on a large force of men next year. All the tunelling that is required is through the spurs of the mountains. The Kicking Horse River falls very rapidly after leaving the summit, and where it covers a distance of three miles the railway takes twelve miles to do the distance. The line keeps on the side of the hill, and it is through some of these spurs that the tunneling is required.

THE Rapid Transit Commission recently appointed by Mayor Edson is to lay out routes for street railways in N. Y., on which the traction cable system is to be used. It is intended to give the system a thorough trial. The commission is similar to the one which in 1875 decided on the routes on which the elevated railways were afterward built. It consists of Messrs. Daniel Drake Smith, Geo. H. Byrd, Thomas E. Stewart, Abraham L. Earle and E. A. Livermore. The latter will probably be made the Chairman. The Commissioners intend about the middle of the month to visit Chicago and inspect the railway system in use there.

THE Pennsylvania, Slatington and New-England Railroad Company has just succeeded in negotiations for a sum of money sufficient to discharge the floating indebtedness and provide for the completion of the line. The company is now rapidly arranging for the payment of all its debts, and construction work will be at once begun again. The bridge across the Delaware at Portland will be rapidly pushed to completion, and the extension of the road through New Jersey into New York State will be made at an early date.

THE CAPE COD SHIP CANAL. Judge Holmes has dismissed the bill in equity brought by Jedediah Briggs against the Cape Cod Ship Canal Company to restrain the defendants from entering upon and taking the plaintiff's land.

The twelve horse-car railroads in New York carried last year, ending Sept. 30, 145,000,000 passengers, or an average of 396,000 a day. The dividends of the company range from 5 to 13 per cent. With the elevated roads to contend with, the horse-car companies appear to worry along.

MOBILE, ALA., December 7.—There is good authority for stating that the Mobile and New York interests in the Alabama Grand Trunk Road have at length agreed as to a programme and that the road will be constructed at once and operated direct between Mobile and Birmingham, thus giving this port another avenue to the coal and iron fields. Work will begin about the 1st of January.

SPRINGFIELD, Ill., December 7.—Articles of incorporation were filed with the Secretary of State to-day, by the Peoria and Northwestern Railway Company, which proposes to construct a railroad from Peoria to Morrison, Ill., and thence to Madison, Wis., and ultimately to Duluth. The capital stock is placed at $500,000, and the corporators and directors are Leander Smith, Charles Spears, Charles Bent, Frank Clendenin, E. B. Warner, all of Morrison.

ALTHOUGH the Indianapolis and St. Louis has expended $1,500,000 in improvements this season, the work of bettering the physical condition of the road has not ceased. On masonry work alone 170 men are now employed. Four new bridges are to be completed this winter. One at Fern was begun to-day. It is of iron and will cost $170,000. At Reno a $6,000 structure is to be put up. At Hillsboro a $5,000 bridge is being put into position, and at Embarrass a fine iron bridge, to cost $17,000, will be built.

WORK has been suspended on the Leesburg branch from Fort Mason of the St. Johns and Lake Eustis Railroad, Florida, and it is not known when a resumption will take place. It is said that the Florida Southern Railway, now trying to get to Leesburg, threatens to go to Orange Bend if the branch above named should be built, and so a game of "check"-ers is being played. So says the *Semi-Tropical.*

AN Ottawa dispatch says that at a meeting of the shareholders of the Ottawa, Waddington and New York Railway Company it was resolved to proceed with the construction of the railway, and in the event of the Government persisting in their refusal to permit the bridging of the St. Lawrence at Morrisburg, to have the cars conveyed across the river at that point by steamer, as is done at Prescott.

ENGINEER George Williams and his corps of assistants have just finished a survey of the Danbury, Ridgefield and Port Chester Railroad. The work of construction will probably be begun before January 1. The surveyors have followed the course previously laid out, with the exception of straightening some portions of the line. The new road will join the New York and New England Road about 1000 feet east of the fair grounds at Danbury, Conn.

Streets, Sewerage and Drainage.

PROPOSALS to pave Union avenue and Mulberry street, Kansas City, with stone blocks are advertised elsewhere in our columns this week. The contracts are to be let on the 5th of January, and as there are about 11,000 square yards of pavement in two jobs, the city engineer is very wisely desirous of obtaining as many proposals for the work as possible.

MORTUARY reports of Pittsburg, Pa., the past year, as compared with other cities, shows that city to be the healthiest in the United States. Last Tuesday with an estimated population of 125,000 there was not one death.

A CONTRACT for $150,000 worth of paving, in addition to $75,000 worth just completed, is to be let in Dallas, Tex.

THE Board of public improvements of St. Louis, Mo., has fixed upon January 2 next to receive bids to pave the following streets with granite at the following cost to the property owners:

Second street from Chestnut to Pine streets, $3.350.

Second street from Carr to Biddle street, $5,650.

Third street from Plum street to Clarke avenue, $13,300.

Poplar street from Seventh to Tenth street, $12,450.

Poplar street from Tenth to Twelfth street, $13,200.

Walnut street from the Wharf to Fourth street, $16,950.

Walnut street from Fourth to Fifth ftreet, $5,400.

Walnut street from Fifth to Seventh street, $7,700.

Walnut street from Seventh to Eighth street, $4,850.

Eleventh street from Poplar to Market street, $38,700.

Eleventh street from Walnut street to Washington avenue, $25,600.

Grand totat cost to the property owners, $186,600.

Bridges.

THE new iron bridge over the Missouri, River at Blair, Neb., thirty miles north of Omaha, is completed.

MEASUREMENTS and soundings of the river have been made, preparatory to contracting for the bridge across the Osage river at Odessa, Mo., for the Kansas City and Southern R. R.

LITTLE ROCK, ARK., Dec. 8.—To-day the directors of the Little Rock and Fort Worth and the Little Rock, Mississippi River and Texas Railroad companies formed a company to build another bridge across the Arkansas river here, to connect the roads now under one management. It will be finished next October.

THE Penn Bridge Co.. Beaver Falls, in addition to a number of other contracts, are completing a heavy 200-feet single span bridge, to be erected in the city of Baltimore.

MILLER, METCALF & PARKIN, of the Crescent Steel Works, Pittsburg are building a new melting furnace, which will be the largest and most complete furnace in the country. The company is also erecting new machine, carpenter and blacksmith shops.

FOLLOWING are bids for the construction of the wrought iron superstructure of the new truss bridge over the new Akron and Cuyahoga Falls road; the distance being 120 feet from abutment to abutment:

Massillon Bridge Co., $29 per lineal foot.

Columbia Bridge Co., $21.45 per lineal foot.

Lomas Forge and Bridge Works, specification A, $29.75; specification B. $33.24 per lineal foot.

Smith Bridge Co., $30.45 per lineal foot.

Canton Bridge Co., $31 per lineal foot.

Morse Bridge Co., specification A, $31.25; specification B, $33.25 per lineal foot.

King Iron Bridge Co., through bridge $29 per lineal foot; half deck, $30.90 per lineal foot.

Berlin Iron Bridge Co., $29.20 per lineal foot.

The bids were referred to a committee of engineers, consisting of C. E. Perkins, R. S. Paul and W. D. Chapman.

THE Keystone Bridge Company are operating every department full, some day and night. They have just completed the Madison avenue bridge for crossing the Harlem river, New York city. It consists of three spans; two of 200 feet and the draw span 300 feet in length.

CLEVELAND'S high-level bridge over Kingsbury Run is an assured fact, the City Council having located the route, The work will cost $250,000.

AFTER a prolonged fight, the Toledo Council has voted to let the contract for the $100,000 iron bridge over the Maumee to the Smith Bridge Co. Twenty-seven bridge companies competed.

THE Pennsylvania Schuylkill Valley Railroad Company have determined to build an iron bridge over the Schuylkill River at the foot of Penn street, this city, to displace the present wooden structure. A previous proposition was made by the company, who desire to enter the city at this point, offering $20,000 toward the erection of an iron bridge, but it was refused by the Commissioners of Berks County under the advice of their attorney, who declared that its acceptance was illegal.

THAT a bridge will be built across the Ohio, at Cincinnati, by the Huntington people, aided by some others, is now an assured fact. The plans for the bridge have been completed, and work on the structure will be begun at the latest by next spring, and possibly before that time. The new bridge, which will be the fourth bridge to span the Ohio at that point, will be built very much after the plan of the Pennsylvania bridge between Cincinnati and Newport, and also accommodations for pedestrians. The cost of the bridge is estimated at $1,250,000.

OTTAWA, Ontario, Dec. 5.—The projectors of the Ottawa and Waddington Railway held a meeting here to-day. It is announced that, as the result of the meeting, a contract for construction will be immediately settled; that plans and specifications of the bridge over the St. Lawrence River will be placed in the company's office in New York, and that a meeting of the stockholders of the company will be held in the first week of January to authorize an issue of bonds. This certainly will look very well in prospectuses, yet there are certain facts which must also be considered which somewhat alter the position of the company. In the first place, the Government will not allow the river to be bridged at the point selected, the Government engineer having reported against the construction of a bridge over the St. Lawrence anywhere between Coteau and Brockville. In the second place, the right of way has not been secured, consequently the issue of bonds cannot be made until there is something to bond. Thirdly, the Canadian Pacific Railway Company has stated that it will soon begin the construction of an air line from Smith Falls to Montreal, passing east and west, instead of north and south, through the counties from which the Ottawa and Waddington Company expects municipal aid.

FIRST AND LAST BRIDGE IN TENNESSEE.—"The first and the last railway bridges built in Tennessee," said Mr. Morris, Resident Engineer of the Nashville and Chattanooga, "show the progress in bridge construction in the State during the past forty-one years. The Hiwassee bridge was the first and the Caney Fork the last bridge constructed in the State. The first consisted of three spans, each 120 ft. in length and 45 ft. in height above the river's bed, resting upon stone abutment and piers. The whole structure, including the masonry, was built by Henry Wilton, of Pennsylvania, over the Hiwassee River for the Hiwassee Railroad. The piers were built upon crib foundations of wood. The superstructure was wood, on the plan of the 'Burr' truss. A small amount of iron was required in its construction. All of the material used in it was of East Tennessee production. The timbers were pine, cut in the forest near the Hiwassee River and floated down the stream to the bridge site. The long timbers were hewn in the forest and ripped open with whip-saws by hand after they were delivered in the framing-yard. The short ones were sawed by the first steam saw-mill in East Tennessee. The whole of the timbers were planed and headed by hand. The iron was rolled in Carter County by the first rolling mill in East Tennessee, and transported in a flatboat down the Nole Chucky, Holston and Tennessee Rivers, and up the Hiwassee River to the bridge opposite, where the bars were forged into the shapes required and the screws cut by a blacksmith and a helper, by hand, in a small shop on the river bank. The bridge was completed in 1842, and the first train of cars ran over it in 1850, pulled over by the engine 'Hiwassee,' which was the first railroad locomotive that entered East Tennessee. The bridge was burned in February, 1862."

"The last bridge built in the State," continued Mr. Morris, "is over the Caney Fork River on the Sparta extension of the Nashville, Chattanooga and St. Louis Railway. It is 795 ft. in length, 126 ft. in height above the bed of the river. The longest span is 219 feet in length. The superstructure is all of wrought iron, on the plan of the triangular truss, resting upon stone abutments and brick piers, built upon stone pedestals set upon solid rock. The superstructure was furnished and erected by the Louisville Bridge and Iron Company, and was completed November 6th, 1883. Engine No. 1, with J. W. Thomas, Sr., at the throttle, ran over the bridge on the day of its completion, and was the first to run a locomotive over it. The bridge was tested by four engines on a span at the same time, under the weight of which the longest span deflected 1¼ in. only at the center of the span.

Water, Gas and Steam.

THE Gaskill compound pumping engine, built by the Holly Manufacturing Company for the Omaha Water Works, was successfully tested on November 26th. It has a pumping capacity of 5,000,000 gallons in twenty-four hours. For the low-service 10,000,000 gallon engine, the bid of E. P. Allis & Co., of Milwaukee, has been accepted by the Omaha Company.

CATSKILL WATER WORKS.—Contracts for cast-iron pipe and specials, have been awarded to the Warren Foundry and Machine Co.; for pumping engines and boilers to the M. T. Davidson Pump Co.; for hydrants to R. D. Wood & Co., being the Mathews Patent.

The pumping station, dock and reservoir are progressing rapidly; some pipes are being laid.

The Denver & Rio Grande R. R. Co. is tunneling a mountain at Bridgeport, Col., near the Black Canyon; total length of tunnel, 2300 feet; 450 men are employed, and four faces are worked at once, an incline tunnel having been run to the centre line of the tunnel. It is expected that trains will run through by March 1, next.

WORK upon the Buffalo Trunk Sewer is progressing rapidly. This sewer is circular in section, 8 ft. in diameter inside, and 22,366 ft. long. About 4,000 lin. ft. are in tunnel, through clay, quicksand and some rock; about 550 ft. of the tunnel is finished. The work throughout is lined with 12 inches of brick work, in three 4-inch rings, each ring being separately laid, an interval of about twelve hours elapsing before the next ring is put in place.

About one and one-half miles of the entire work is finished. Collins & James, of Detroit, have the tunnel contract at $29 per lin. ft. complete. Foltz, Ashman & Co., have the greater portion of the work; Evison & Dalameter, of Cleveland, O., are also contractors. Col. Geo. E. Waring, jr., is the consulting engineer.

"After an experience of three years it is certainly very suspicious that it never occurred to him (Com. Thompson,) how sadly the city was in need of test pits, and how uniformly the amount of rock and earth got reversed. He must have known, being a business man, the workings of an unbalanced bid, and that he would not in his own private affairs have let a list of bids go by unexamined which ranged in price from 1 cent to $30 per cubic foot. Mr. Thompson's faith in the recuperative power of a surveyor's judgment must have been great indeed since he goes a second time to a man for an estimate when on a previous case he had estimated that there were 10 cubic yards of rock where there were in reality 121 cubic yards. If the *Evening Post* interviewer correctly gives Mr. Thompson's defense, one cannot but admire the assumption of the commissioner's position that under the compulsory statute the department has been forced to make losing contracts to the tune of $6,000,000.

Just at this juncture it is edifying to learn that Philadelphia has also on hand a street-contract disclosure. During the centennial year a deal of money was put out in cobble-stones. It now appears that the city paid for them standing, but that the contractors really laid them in the streets on their sides. By a peculiar forgery practiced in mandamus proceedings the bills were also "stretched," and all Philadelphia is now talking cobble-stones and corruption."—*Springfield Republican.*

WORK on the Brush Valley Water Works at Centralia, Columbia County, Pa., has been suspended for the season.

THE Greenville (Pa.) Water Company, capital $84,000, has been incorporated at Harrisburg.

MR. DOWLING BENJAMIN, the Camden scientist, has begun collecting water from the rivers of Pennsylvania and New Jersey and subjecting them to analyzation, so as to determine if the germs in the water are the cause of disease now so prevalent in the cities using the water.

WELLINGTON'S, Kansas, water works have been located and work commenced. The contract requires the completion of the system next July.

FIVE men, residents and property owners of London, Ohio, have applied for a charter to build water works for that place.

IN order to rid it of impurities, Hope reservoir, in Providence, R. I., has been allowed to run dry, 76,000,000 gallons of water being wasted.

THE Missouri river failed to keep its contract with the Wyandotte Water Company, and without notice shifted its bed, leaving the company's suction pump high and dry of anything to suck. George B. Inman, the contractor, has had the pipe extended into the new-made channel, which is several rods further from Wyandotte than it was two weeks ago. Mr. Inman's first idea was to place a pump out on the sand bar and in that way fill the reservoirs, but fearing that it might be as fickle as the channel which had deserted him, he decided to follow the channel wherever it goes.

ENGINEER WATSON is making surveys for the new Dalton, Berkshire County, Mass., waterworks. He finds that the best reservoir can be constructed on the Cleveland brook, about two miles east of the village. The fall will be about 200 feet. The water company has been formed and will ask to be incorporated by the Legislature. The capital stock is $50,000.

MR. JOHN C. PRATT, President of the Jamaica Plain Gas Light Company, has had printed in two neat pamphlets a paper on "The Future of the Gas Interest," read at the meeting of the American Gas Light Association at Pittsburg, October 18th, 1882, and a paper on "The Successful Gas Manager," read before the same association at a meeting held in New York, October 17th, 1883. In both of these papers Mr. Pratt recognizes fully the fact that gas companies, deriving certain important and valuable privileges and powers from the public, are under equally important obligations, which may be summed up in one item—the duty of rendering the most complete service possible at the least possible expense. He suggests a more confidential relation between the companies and the public than now exists, as the public having an understanding of the affairs of the companies would have less cause for fault-finding and discontent than is supposed now to exist. In discussing the future of the gas interest Mr. Pratt sees very clearly the danger which menaces it from the competition of electric lighting, and points out that there are other fields for gas than that of illumination, but at the same time suggests plainly that this field can be held by furnishing gas as cheaply as possibly, as it will be easier to hold the field by making it difficult for competition to enter than to drive out a competitor once fairly entered.

SUSPENSION BRIDGE, N. Y., are asking for bids on a 5,000,000 gall. pumping engine, a set of boilers and other material.

HAMBURG, N. Y., is being surveyed for waterworks. C. B. Holly, of Lockport, has been there, and is preparing a bid.

NEW YORK, Dec. 8.—The Board of Aldermen to-day requested the Board of Health to communicate to them the number of deaths occasioned by the use of electric wires in the city during the past three years, and also called upon the Fire Department to report to the Board the number of fires occasioned by electric wires during the past three years, the estimated damage caused thereby, and also any damage to life or limb to any members of the Fire Department arising from the same.

THE Croton Aqueduct Commission, Mr. Dowd being absent, met December 4th, for the purpose of hearing any objection that might be offered to the proposed modified line for the aqueduct, but no one appeared to make argument. It was resolved to instruct the engineers to prepare plans of the modified line from the Harlem River to the point near Sing Sing, at which the routes suggested to Quaker Dam and the Croton Lake diverge. It was also resolved to close the public hearing on that part of the route on Friday, December 7th. Argument on the line from the point of intersection northward will be heard for several weeks to come.

FRANKLIN, Pa., City Council, is discussing the erection of water works.

WITH the completion of the new artesian well at Charleston, S. C., probably by the 1st of January, the daily water supply of that city will be increased to about 800,000 gallons, or four times what it is now

THE Boston Water Board are out with an appeal to consumers to practice the most rigid economy in the use of water, as the supply for the city beyond twenty or thirty days, if the drouth continues, is extremely precarious. Pumps have been working to supply Lake Cochituate since November 26th. The city has consumed 29,080,000 gallons a day for the past month, eight per cent. less than for the same time last year.

AT the meeting of the Philadelphia Councils' Committee on water on the 4th, the Bell Waterphone Company of Cincinnati, made a proposition to lease its system and waterphones to the city for one year for the sum of $5,000, renewable, at the discretion of the city, for the sum of $4,000 thereafter, with the proviso that should the city desire to purchase, during the year 1884, for $25,000, the rental of of $5,000 may be deducted therefrom. Chief Engineer Ludlow favored the adoption of the system. He said fully forty-five per cent. of the total pumpage now went to waste. It is in use in many other cities throughout the country, and, it is claimed, has caused a great saving of water by stopping the waste. The proposition was referred to a committee. An ordinance was introduced to empower the Chief Engineer to have fire-plugs put in at the intersection of streets where in his judgment they are necessary.

THE following are the bids for pipe opened by the Minneapolis, Minn., Water Committee on the 5th:

Dennis, Long & Co., Louisville, Ky.—	
15,650 feet 6-inch, 35 pounds per foot	$34 56
8,350 feet 8-inch, 50 pounds per foot	33 74
900 feet 10-inch, 70 pounds per foot	33 59
4,310 feet 12-inch, 90 pounds per foot	33 16
9,886 feet 24-inch, 250 pounds per foot	31 43
Cincinnati & Newport Iron Pipe Co.—	
6-inch pipe	$34 39
8-inch pipe	33 49
10-inch pipe	33 49
12-inch pipe	32 99
24-inch pipe	31 25
Shinkle, Harrison & Howard, St. Louis, Mo.—	
Pipe, all sizes	$33 94
For branch castings, per pound	3½c
A. H. McNeal, Burlington. N. J.—	
6-inch pipe	$40 00
8-inch pipe	40 00
10-inch pipe	39 50
12-inch pipe	37 90
24-inch pipe	34 00
Gloucester Iron Works, Gloucester, N. J.—	
6-inch pipe	$34 79
Warren Foundry & Machine Co., Wm. Runkle, New York—	
6-inch pipe	$34 79
9-inch pipe	34 70
10-inch pipe	33 35
12-inch pipe	33 35
24-inch pipe	33 35

THE contract for supplying Minneapolis with water pipe for the ensuing year, has been awarded to the Cincinnati & Newport Iron and Pipe Company for all sizes of pipe, viz.: For 6-inch pipe, $34.39; 8-inch, $33.49; 10-inch, $33.49; 12-inch, $32.99; 24-inch, $31.25. The total number of feet of pipe laid this season is 16,016½; hydrants placed, 32; rock excavated, 531 yards.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, Dec. 14, 1883.

A number of large transactions in Forge Iron have been reported within the past three or four days, and the result is that for inferior brands, some makers are holding prices with a little more confidence, and the indications to-day are, that considerable business will be done between this and the end of the month. The reason assigned for this sudden and unexpected spurt of activity is, that the parties who are buying are large consumers who have very little material on hand, and that an improvement in demand and prices is confidently expected after the opening of the year. Whatever force there may be in these conclusion, the fact is, that some large lots, mostly of inferior irons, have been moved, for the reason that these irons can be had on easier terms than the better makes, and are in greater abundance. Some of the standard special brands are held pretty high, and makers show no disposition to unload at concessions. There is a slight decline in stocks from reporting furnaces, and this favorable indication helps prices. The increase in production is too light to affect quotations. Foundry Irons are $20@$22 for No. 1, $18.50@$19.50 for No. 2, $18 for Gray Forge. Muck Bars are dull at $33; Blooms, $37 for charcoal, and $47 for Anthracite. Merchant Iron is very weak, but there are inquiries for several large lots, owing partly to the fact that a good many mills will close down this week, and remain out until after the first of the year. This will certainly help the trade, but it is impossible to say how much, as there is now far more capacity at work that is needed to fill all requirements that are being presented. Skelp Iron has sold in several large lots. Merchant Bar is to be had at 2c. down to 1.75. A good deal of Old Iron has been bought to fill requirements for cars which have been ordered by various railroad companies. Plate Iron is weak and dull; Small lots are moving at 2.30@2.40. No large sales of Steel Rails have been made, but there are numerous inquiries and offers at from $1@$2 below minimum quotations, which are given at $35. Leading brokers negotiating for Structural Iron say that during January large orders will be placed. Bridge Works have a good deal of work ahead. Old Material is wanted at $23@$23.50 for Tees.

PITTSBURGH, Dec. 14, 1883.

The movements in the iron trade lack interest. Large and small consumers are buying only for present needs. There are rumors of a strong upward tendency in prices after the first of the year, but some large buyers declare this to be improbable, because stocks are large, and makers very anxious to sell. Hence, the activity in Pig Iron, whatever it may be, will not show itself for some weeks to come. Steel Rails are quiet at $35; Old Material is inquired for and would sell at $23.50@$24. Merchant Iron is weak and fluctuating at 1.75@1.90. Plate Structural Iron are in better demand, and mills are busy. Nails are weak and quotations as low down as $2.40. Large consumers are purchasing only jobbing lots. The rescinding of the resolution to restrict production, has frightened consumers off. The managers of the Edgar Thomson Steel Works will meet a committee of their workmen in a day or two to consider the question of wages. The miners are beginning to have a rough time of it, as one-half of the mines are being idled, owing to slack demand. The attempt to arbitrate the difficulties upon the Monongahela, has not been a success. There are prospects of an early settlement of the glass strike.

CHICAGO, Dec. 13, 1883.

No improvement can be reported in the iron market a this point, and none is now expected until after the opening of the new year. Manufactured Iron is very dull, and is moving in small lots only; prices are weak and unsatisfactory, and liberal concessions can be obtained below 2c. A good deal of Bridge Building is in sight, and large orders will be placed early in January Galvanized Iron is without activity, and weak at 45@50 per cent. off. Black sheets are in light demand. Norway and Swedish Iron are wanted in small lots. Demand for Russian Iron is dull. Nails are very dull, owing to the fact that a great many more than are wanted, are being turned out. Quotations, $2.65@$2.75; Pipes 75 per cent. off. The Steel trade is dull, and large concessions are offered to move large lots. Steel Rails are under better inquiry and quotation are $37 in western mills for best. Buyers are demanding concessions which are not granted. Pig Iron makers decline to shade prices below quoted rates. Southern and Charcoal Irons are in better request than others. One lot of 500 tons of Alabama Iron sold at $20. All the southern furnaces are doing well, and are attracting more attention, on account of the low price and superior quality of their products. Several of them are oversold. Hardware, both shelf and heavy, is in fair demand; winter goods especially, are being bought freely. Builders' Hardware is dull, as the building season is about over.

COAL.

NEW YORK, Dec. 14, 1883.

It is the policy of the Anthracite Coal producers to restrict production from this time out, until prices have advanced above circular rates. The reason for this is, that production is a little too heavy for the market, and in consequence of this, it is impossible to ask outside prices. Last week, a general break took place in Coa quotations, and large buyers purchased freely, knowing that a restriction was contemplated. Eastern markets are pretty well supplied for the present, but the stocks will, in most cases, be exhausted within 30 days. A steady winter demand is anticipated from New England. The condition of the western market is satisfactory, as stocks are far below what will be needed for the next 60 days. Heavy rail shipments will be made this winter. Stocks at Philadelphia are unusually large, running above 150,000 tons at Port Richmond. Vessels are scarce and freights high to both Northern and Southern ports. The local demand in Pennsylvania is light, excepting for domestic sizes, which are very active. Production up to this date falls very little under 20,000,000 tons. The 12 days suspension will take about 1 250,000 tons of coal out of the market. The eastern Bituminous Coal trade is very dull. Average output of Pennsylvanian and Maryland Coals, 150,000 tons per week. The excess of these Coals, so far this year, are about 1,500,000 tons over last year, and of Anthracite Coal, 2,500,000 tons, making a total excess of 4,000,000 tons over last year. A large number of new Bituminous mines are being opened in Virginia and Pennsylvania, and the increase in supply next year, will be very great, and unless a very great improvement takes place in demand, sharp competition will drive operators into a further restriction.